PC MAGAZINE

SOFTWARE

PC Tools vs. Norton: The Big Showdown in Disk Utilities

FIRST LOOKS

Great Color Printing for Under $1,000

HP's DeskJet 500C

SOFTWARE

Triple Your Hard Disk Space with On-the-Fly Compression

FREE UTILITY

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JANUARY 28, 1992 THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOLUME 11 NUMBER 2

Lightweight Low-cost Laptops

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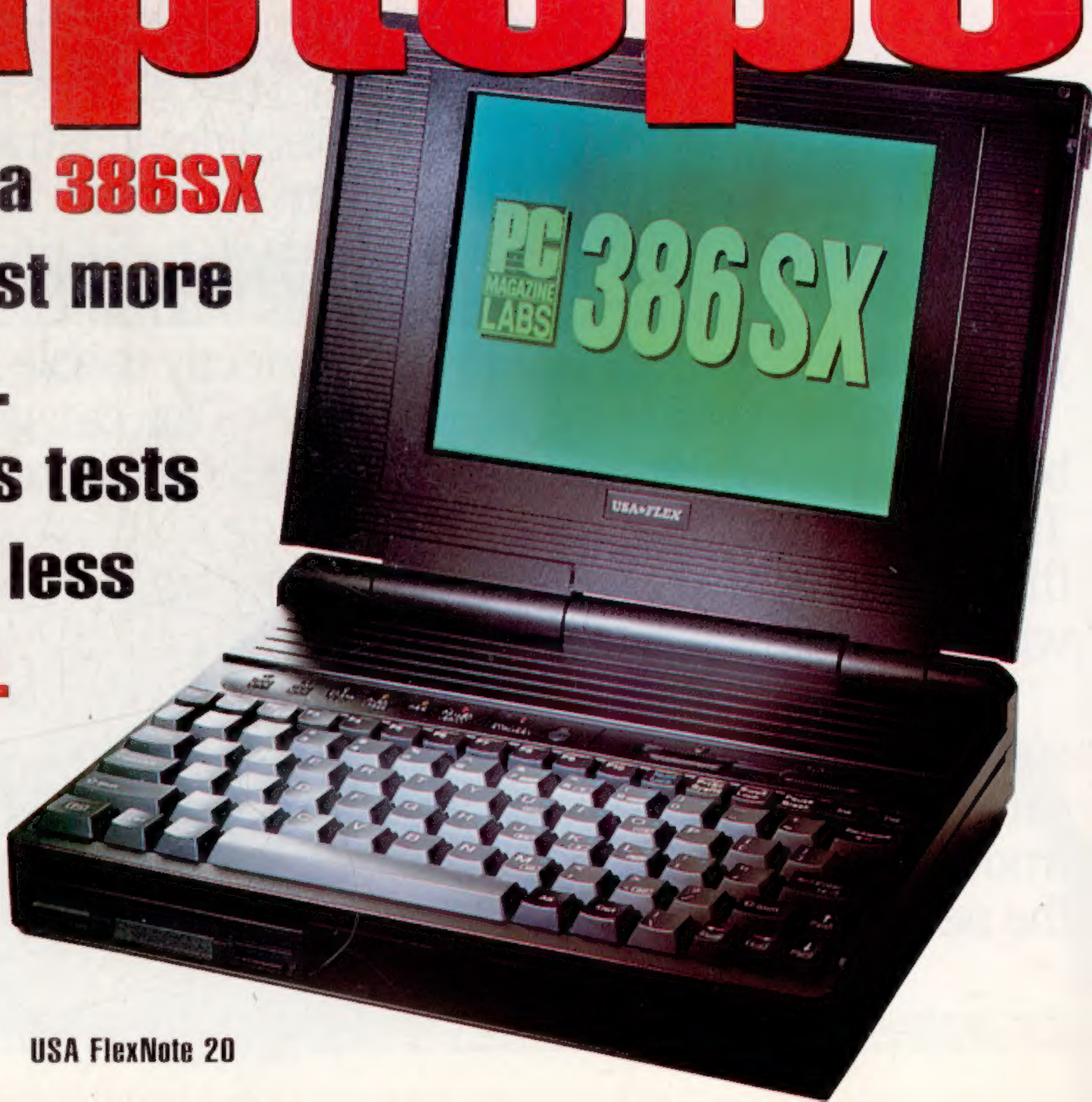

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TUESDAY, NOVEMBER 5, 1991

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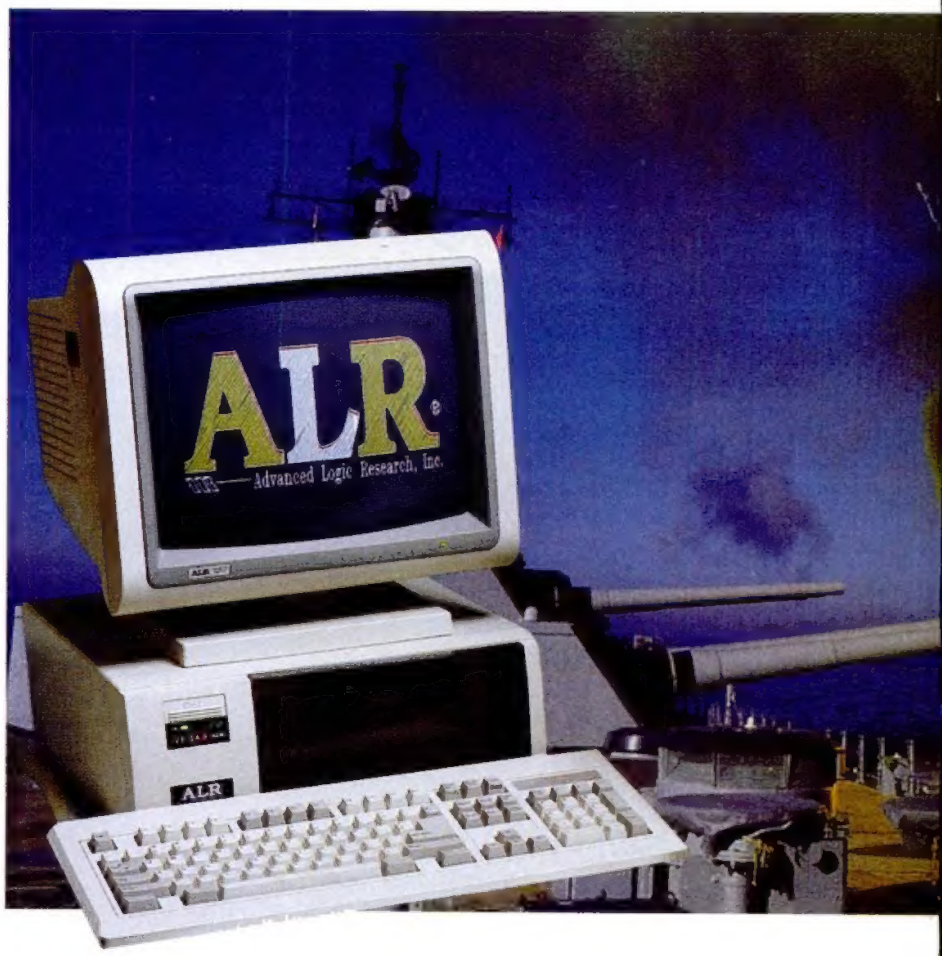

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Inside

If someone offered to replace your hard disk with one that was two to three times as big, ran just as fast (or maybe a little faster), and cost less than $200, you'd probably be interested in the deal.

We certainly were, and our curiosity led to this issue's evaluation of on-the-fly data-compression programs. Unlike compression utilities such as PKZIP, these real-time programs compress and decompress data every time you access your hard disk. The result, depending on your personal data mix, is an effective doubling or tripling of your disk's storage capacity.

PC Labs technical analyst Bill Bettini devised a testing procedure that combined hard disk performance tests, compatibility tests, and data-compression tests across a wide variety of file formats. The investigation yielded some surprising findings.

PC Labs technical analyst Bill Bettini created our on-the-fly data-compression performance tests. The results were surprising.

"We expected to see some performance degradation because of the overhead of compression," says Bettini. "Instead, we found that hard disk performance can actually be enhanced by these programs. The act of compression happens in fast memory, and the hard disk then accesses the compressed files. Less disk access means better disk performance, especially when you're moving big chunks of data, as we did in our testing."

Bettini also said that he thought he would see better performance from the add-in coprocessor boards some products include. "In most cases, we found that the software is a completely satisfactory solution all by itself."

What about compatibility problems, once the bane of on-the-fly compression programs? For the most part, they've been taken care of, and the programs come with plenty of caveats about using (or not using) disk utilities and disk caches on compressed drives. The only warning Bettini gives is to be careful when you run Windows; you have to remember to swap data to a noncompressed partition.

On-the-fly compression is extremely useful on portable PCs. Though large hard disks are starting to show up in portables, they can be very expensive, and today, the majority of portables still come with hard disks no larger than 40MB. If you're in the market for a new portable, be sure to check out this issue's roundup of 15 machines priced under $2,000.

And consider maintaining your hard disk with an upgrade of your favorite disk utility package. This issue's evaluation of *The Norton Desktop for Windows, The Norton Utilities,* and *PC Tools* highlights the newest features of these ever-expanding utility collections.—*Don Willmott* ■

PHOTOGRAPHY: THOM O'CONNOR

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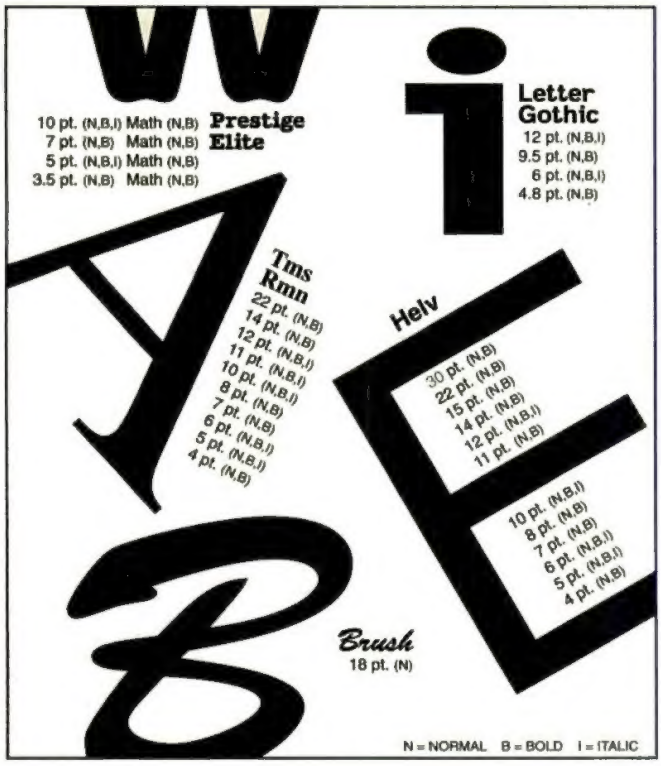

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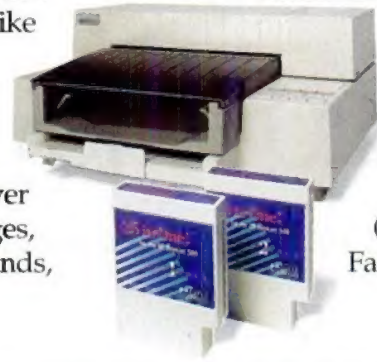

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January 28, 1992

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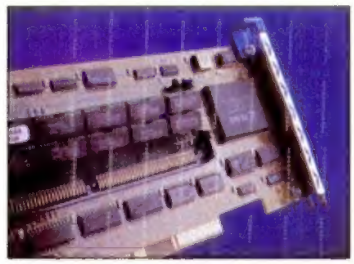

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Letters

UAE SIGHTINGS

Bill Machrone's "Windows Bugs: Conspiracy of Silence?" column on Windows' UAEs (Unrecoverable Application Errors) in the October 29, 1991, issue is a typical instance of LUW (Life Under Windows—an oxymoron if ever there was one). I myself put up with UAEs only because I like to use *CorelDRAW*, a fine product for which there is currently no DOS version.

However, Mr. Machrone failed to mention the consequences of UAEs, namely UCRs (Unrecoverable Consumer Resources) and UPBs (Unbearable Pains in the Butt). Furthermore, when the occurrence of UCRs and UPBs achieves some critical minimum level, one observes the generation of UKDs (Unexplained Keyboard Destructions) and UMTs (Unstoppable Mouse Trajectories).

What is most puzzling, though, is that in spite of the UAEs, the UCRs, the UKDs, and all the other related side effects of this abysmal product, Windows continues to generate UMPs (Unjustified Microsoft Profits).

Manny O'Rourke
Boulder, Colorado

I can relate to Bill Machrone's Windows UAE problems. You see, I too thought I was the only one. As a new Windows 3.0 user, I experienced a rather sudden onset of UAEs. Because I was installing so much new software and trying to configure as I learned, it was difficult to tell exactly where things went wrong. I eventually made a call to the big guys up north.

Twenty-five minutes and several dollars later (20 minutes of which was spent in that cute little Microsoft holding queue), I was told that they were sorry, but I had a UAE problem and there was nothing they could do.

Later I discovered that the problem was with a faulty display driver. Since fixing the display driver, everything runs normally.

Phillip Hoffman
Santa Ana, California

You are not alone: UAEs are a nasty way of life for many Windows users.

IN THE GOOD OLD DAYS

Bill Machrone's column on keystroke travel and sound ("Keyboards: The Desktop Dinosaurs," November 12, 1991) reminded me of an old computer war story:

In the late 1960s, I worked on one of the first key-to-tape systems, designed to replace banks of IBM keypunch machines. Each key station consisted of a keyboard and a 1-line, 80-character nixie-tube display. The data from each station went to a central supervisor's station with a reel-to-reel tape drive for storage.

The designers were concerned that the keypunch operators would be uncomfortable if they did not hear the heavy sound of the punch dies each time they pressed the key. Therefore, they added a relay to the design so that each keystroke produced a loud, satisfying clank.

Larry R. Groshart
Sunrise, Florida

A POST-CHRISTMAS WISH LIST

Regarding Mr. Machrone's column on keyboards and Mr. Seymour's column on computer ergonomics in the November 12, 1991, issue: I think that the floppy disk drive in the keyboard is a great idea. But why stop there? Why not put a master on/off switch and a parallel printer data-transfer switch on the keyboard as well? This would greatly help those of us who have more than one printer and also have other desktop devices that need power and data signals.

B. Hollis
Greenville, South Carolina

THE KILLER APP

I think Michael J. Miller has the wrong idea about the "killer application" ("The Killer App," October 29, 1991). Operating systems and platforms do not initiate killer applications; they are merely the lucky message bearers. Hardware innovation is what produces them.

It was the Apple II and its floppy disk drive that made *VisiCalc* possible. Lots of RAM made *Lotus 1-2-3* possible (remember, RAM was a big deal at that time). And the LaserWriter made programs like *PageMaker* viable.

These killer applications, made possible by hardware, then fueled the success of that very hardware and its operating system. Another new device is what we need for the next era of software.

Fred Bruen
Burlingame, California

A BRIGHTER VISION

It's disappointing to see Jim Seymour's timid imaginings about the future of software ("2001 Part II: Software That Knows Us," October 29, 1991). Ten years is an eon in the computer world; as the pace of new technology and innovation continues to expand exponentially, the capabilities of the software we'll be using in ten years will be just barely conceivable.

Imagine a vastly more knowledgeable and powerful personal assistant than the one Mr. Seymour describes. This system would be fully voice-addressable with recognition sensitivity to its owner's particular nuances of speech (timing, hesitations, inflections), and would have plenti-

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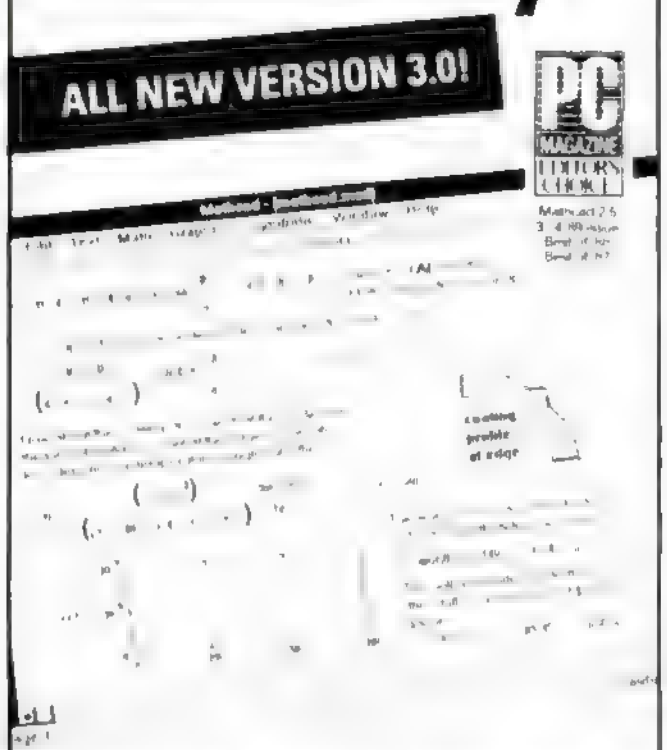

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Think bigger, Jim. I would urge you to take the sentiment expressed near the end of your column more to heart. "The risk . . . is that our vision is too small, our dreams not large enough." As Shaw suggests, take the time to stop and ask "Why not?"

Stephen Chrysostom
Omaha, Nebraska

RETURN TO SENDER

In your November 12, 1991, Letters section, Daniel McMillen said, "Saying that continued support should be included in the original product's price would be like the doctor charging a lifelong office-call charge for delivering a baby." If the doctor had as much to do with the development of the baby as the software designers have to do with the software, the doctor would be the parents, and therefore responsible for the baby (including all office-call charges) for 18 years.

James C. Hamilton
Ann Arbor, Michigan

A MISQUOTATION?

I would appreciate your attention to the Pacific Data Products ad in your October 29, 1991, issue (page 212). You have been misquoted, and people reading your magazine have been misled. Pacific Data Products has included in its ad a quote from a *PC Magazine* review stating:

"The native 35 PostScript-compatible fonts in PacificPage XL are Bitstream designs, some of them superior to Adobe's version."

The original quote in a First Looks review (June 25, 1991, page 38) has one additional but significant word that was deleted from Pacific's quote:

"The native 35 PostScript-compatible fonts in PacificPage XL are Bitstream designs, some of them *slightly* superior to Adobe's version." (Emphasis added.)

Oversight? I doubt it. Do your readers a favor: Point this out in your next issue, and let your advertisers know that you (and we) will not tolerate misleading misquotations in the magazine!

Richard Mechaber
Concord, New Hampshire

ON OS/2 AND ZACHMANN

When your magazine arrives in the mail, I immediately do two things: First, I shake out all the loose subscription cards; then I turn to William F. Zachmann's column to read his newest wrinkle in drum beating for OS/2. You need to understand that I don't know anything about OS/2, have never seen a computer run it, have never seen it in a store, and have never met anybody who has even thought about using it.

The reason I turn to his column is that I feel a certain empathy with his railing against the forces that have kept OS/2 in obscurity. My favorite programming language, you see, is Forth, and Zachmann's columns are strongly similar to articles in *Forth Dimensions* magazine that bravely suggest that if programmers would only learn Forth, they would instantly abandon their C compilers.

Perhaps Zachmann could spice up his column with some Forth programming techniques for OS/2. This will entrench him even more firmly in the Twilight Zone and cause me to read him before I shake out the loose subscription cards.

Doug Milligan
Albuquerque, New Mexico

VAPOR-INCHES

After reading your First Looks review on the new NEC 15-inch 4FG monitors ("NEC 4FG: A MultiSync for Modern Times," November 12, 1991), I went out and purchased the 15-inch 3FGx. I compared it with my 13-inch MultiSync II, and was shocked to find only a 1/2-inch difference in screen diagonal measurement. The alleged 15-inch monitor was really a 13.5-inch monitor!

In addition to vaporware do we now have vapor-inches, or has the electronics industry invented the incredible shrinking ruler?

Roger Novak
Reston, Virginia

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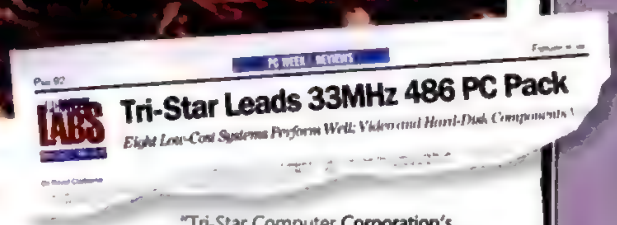
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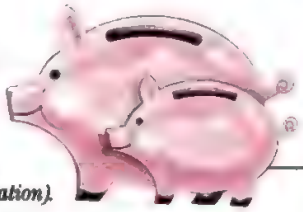

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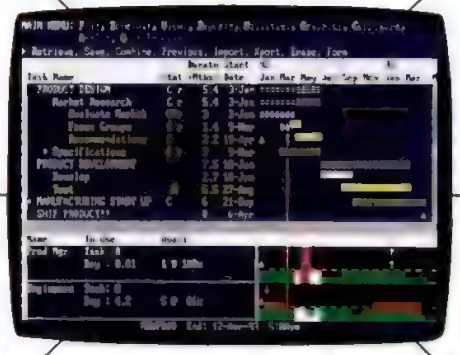

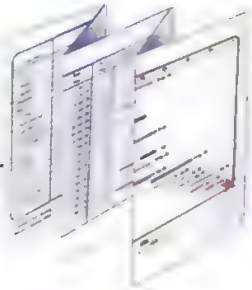

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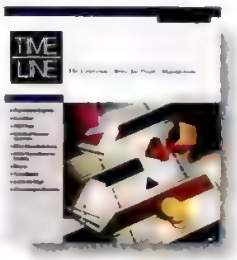

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CIRCLE 332 ON READER SERVICE CARD

Letters

like to suggest the following standard definitions:

- Portable: Anything with a handle, even if it is heavy and awkward. Example: early Compaq portable.
- Laptop: Traditional clamshell-type portable—heavy and battery-hungry. Example: early Toshiba, and most clones.
- Notebook: Ultraslim clamshell computer with a longer battery life but a cramped keyboard. Example: Texas Instruments TravelMate 2000.
- Notepad: A true flat, slate-type, pen-based PC—but no keyboard. Example: NCR 3125.
- Palmtop: Smaller than a videotape and not quite as useful, but still bigger than most pockets. Examples: Hewlett-Packard 95LX, The Poqet PC.

David R. Chalmers
Dundee, Scotland, United Kingdom

In your article "SX Power, AT Price," in the November 12, 1991, issue, why did you leave out Gateway 2000 as a vendor in this price and feature category? From Gateway's ads, it seems apparent that Gateway machines are better values than the machines you reviewed. Am I missing something here?

Matthew Denton Sopher
Clarion, Pennsylvania

When we asked 250 vendors to submit their lowest prices for this story, in May 1991, Gateway 2000 responded that it could configure a 20-MHz 386SX with 2MB RAM, an 80MB hard disk, VGA color display, and DOS for $1,820. Eleven vendors submitted lower standard-configuration prices but also failed to meet our $1,600 cutoff.

PC Magazine chooses systems based on current information as supplied by the vendors. We cannot always accommodate vendors who lower their prices after our editorial deadlines.—*Ed.*

CORRECTIONS & AMPLIFICATIONS

Readers may have noticed a minor style change that was introduced in the previous issue of *PC Magazine:* Microsoft Windows 3.0 is no longer italicized. Our long-standing style is to italicize the names of application software *(Lotus 1-2-3, WordPerfect)* but not operating systems (DOS, OS/2). We now perceive that Windows, as an operating environment and extension to DOS, has more in common with an operating system than application software, so it's Windows, not *Windows.*

In the New and Improved column, November 12, 1991, issue, we should have stated that Irwin Magnetic Systems' low-cost line of AccuTrak minicartridge tape backup systems do not connect to an RS-232 port. The drives connect to a standard Irwin floppy disk drive controller interface card or, for accelerated performance, to Irwin's optional SuperTrak 4100 controller, which provides a data-transfer rate of 1 megabit per second.

The prices for the TEAC drives in the November 26, 1991, New and Improved are $200.49 for the FD-505 Dual Media Drive (which combines both a 3.5- and a 5.25-inch floppy disk drive in one half-height drive bay) and $2,495 for the OD-3000 optical drive.

We printed the wrong test results for Datasouth's 18-pin Performax dot matrix printer in our November 26, 1991, special printer issue. The correct draft text speed is 308 characters per second; the correct letter-quality text speed is 100 cps, while graphics speed is 3.1 graphics pages per minute.

In the May 16, 1990, issue of *PC Magazine*, a utility called PAN was published. PAN is a registered trademark for electronic services for the entertainment industry owned by the Pan Network. For this reason, our utility, which continues to be available, has been renamed PANDORA. Further information regarding PAN can be obtained from the Pan Network at P.O. Box 162, Skippack, PA 19474; 215-584-0300.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments, complaints, and suggestions. Please send them to Letters, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see page 10 for access information). All letters become the property of *PC Magazine* and are subject to editing. ■

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CIRCLE 488 ON READER SERVICE CARD

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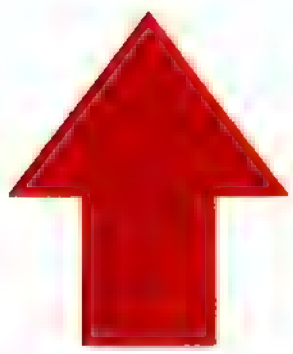
The first monitor for people who know which red is the right red.



*NEC, who brought you the first color laptop computer and affordable color printers, now brings you the **only** color monitors with the AccuColor Control System, an unprecedented step in user-adjustable color accuracy.*

You can match the red on your letterhead, the red on a slide, even the red on your favorite tie. And you can do it easily.

With NEC's new MultiSync® FG™ series monitors.* Our revolutionary AccuColor™ Control System allows you to adjust image colors to your exact needs.

This new color calibration system lets you match colors on your screen to Pantone® or any other color reference system. You can also match on-screen colors to those delivered by your color printer, another monitor, or a service bureau output.

Whether your monitor needs are for general business use, multi-media applications, or color prepress, you're probably relying on color more than ever. And we've made it easier than ever to match the color you need. You can actually set the red, green, and blue color guns in precise digital steps to adjust the colors on the display.

The FG series also gives you sharper graphics and text. So even if you're not one of those people who knows which red is the right red (top row, fourth column), the answer to your monitor needs couldn't be clearer.

Call 1-800-NEC-INFO. (In Canada: 1-800-343-4418.) For immediate info via fax, call NEC FAST FACTS, 1-800-366-0476. Request #1521.

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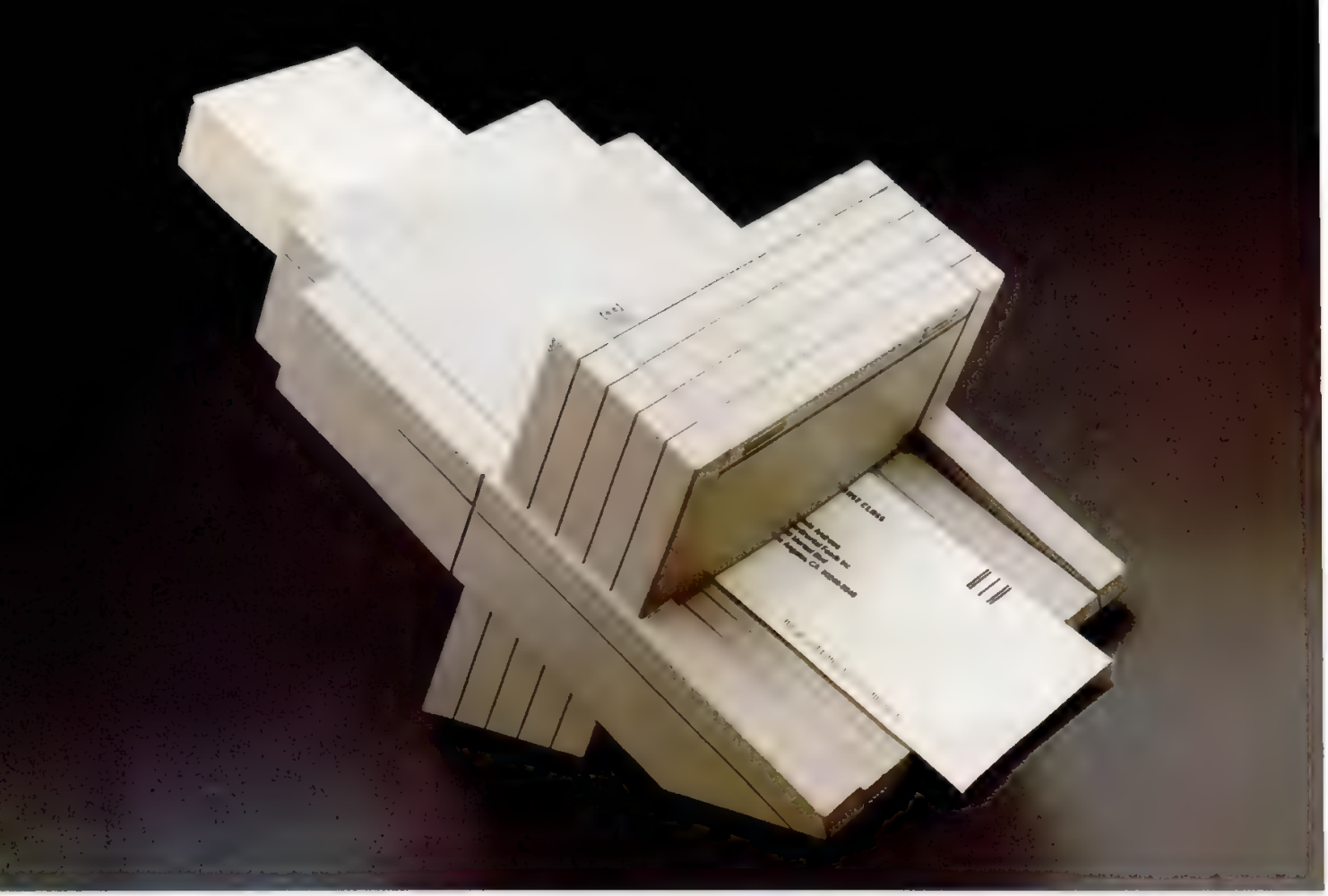
CIRCLE 153 ON READER SERVICE CARD



Actual size: 8.7" x 8.5" x 8" (HWD)

Introducing the AddressWriter. The amazing new printer that takes the aggravation out of printing envelopes, postcards and labels.

With all the breakthroughs in office automation and computerization you'd think that by now there'd be an easy way to deal with envelopes. Well, there is: The AddressWriter™ from CoStar.

This neat little printer will shoot out a beautifully printed envelope, postcard, or label, complete with postal bar codes, in seconds.

The AddressWriter comes with its own memory resident addressing software (a TSR) compatible with most applications. With just one keystroke, you can set the software to *automatically* find the address in your letter, and print an envelope while your main printer is printing your letter. Or you can set the AddressWriter to print all the envelopes for a mail merge file while your main printer handles the letters. If all you need are envelopes, print from the AddressWriter's built-in database, or import lists from your favorite programs.

Mr. John Armstrong
756 Larabee Lane
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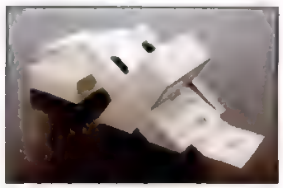
In every case, the AddressWriter will print the POSTNET® postal bar codes that speed mail delivery and can save you up to 20% on postage.



It becomes a great label printer with $75 label feed attachment.

The AddressWriter lists for $595. **For more information, or the name of a dealer near you, call 1-800-4-COSTAR or 1-203-661-9700.**

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CIRCLE 184 ON READER SERVICE CARD

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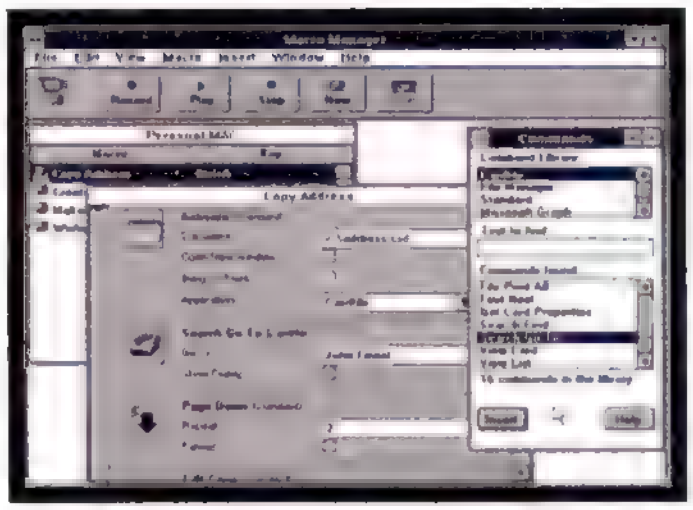
Trends

Trends & Technology Shaping the Personal Computer Market

Windows Apps To Get Common Macro Language

Today, macros that automate repetitive tasks are specific to each application: each one speaks its own dialect. But if Microsoft gets its way, there will be a universal tongue for macros and it will work across all Windows applications. So far, Aldus, Borland, Lotus, Micrografx, and WordPerfect like what Microsoft is saying, and they are planning to cooperate in toppling the macro Tower of Babel.



Macro Manager will let you build a macro by dragging and dropping commands.

Using the still-unfinished OLE (object linking and embedding) 2.0 Command Architecture specification as the plumbing, the universal macro language lets users build compound documents with elements from different applications and automate processes that use pieces from multiple vendors.

Microsoft's Macro Manager will let users write cross-application macros by recording keystrokes or clicking on commands. The complexity of writing these macros will be minimized using extensive icons and dialog boxes. A Macro Recorder and Viewer are planned

The core macro language is derived from Basic. Microsoft plans a future version of *Visual Basic* that can read, edit, and compile Macro Manager's output.

In OLE 2.0, the Command Architecture will maintain a database of commands. Each application will install its own application-specific commands into the database. The macro language would have commands such as EditCut for a word processor, or SumRange for a spreadsheet. Applications would be able to access the commands of other applications through the OLE 2.0 link.

Macro Manager will require OLE 2.0, which does not even have a release date yet. A more modest version of OLE will appear in Win 3.1 when it ships this March.—*Christopher Barr*

Gates Sees 1,000 Percent Boost for PCs

What will PCs and software be like later in the nineties? Here's the vision outlined by Microsoft chairman Bill Gates at the company's mid-November Applications Technology Briefing for editors and analysts:

Within three to five years, PCs using the Intel 80586 or Windows-compatible MIPS 4000 chip will have ten times the power of today's SX-based systems, yet cost no more than today's SX. Standard equipment will include a 400MB hard disk, a cheap removable rewriteable optical disk (not a CD-ROM) of 400-plus megabytes, and a 2,048-by-2,048 pixel color display.

"The mouse will play a diminished role," Gates said. It will be supplanted by pen, finger, and voice input. By decade's end, there will be just two kinds of networks: 10 megabit-per-second wireless and 100Mb fiber-optic. The higher 10 times CPU power may give PCs enough horsepower to display full-motion video on-screen.

Other likely displays (all in color) will include a 6,144-by-4,096 "whiteboard" for workgroups, a 1,280-by-1,024 laptop display, and a 640-by-480 wallet computer display. With character crispness nearly equal to laser printer output (or so the eye believes), reading documents on screen won't be slower than on paper. Today, Gates said, "It's considered rude to send an electronic message longer than two or three screenfuls."

Gates sees users standardizing on a handful of software programs from large companies. Non–Top 10 software companies will turn to creating add-ins and custom tools to enhance and differentiate the "top-level programs."

The next DOS will probably have file-transfer abilities built in. Later versions of DOS or Windows get real networking, electronic mail, and the ability to see file contents through viewers (a la Lotus's *Magellan* or *PC Tools*). Privately, Microsoft officials said that while there's lots of publicity surrounding Windows-NT (tentatively shipping at year's end), it's only for a minority of users because mainstream applications will probably run faster on Windows 3.0/3.1 and its successors.
—*Bill Howard*

Buy Your Next LAN from Sears?

Although "shrink-wrapped" may be a bit of a stretch, Packard Bell's new network offering certainly takes the headaches out of choosing and installing a LAN. Packard Bell, one of the top 20 PC clone makers, is taking a systems-integrator approach by combining all the hardware, software, and services a small business or workgroup will need to buy and install a network.

Packard Bell provides one-stop shopping for networks.

The company joins a growing number of vendors who are targeting the networking needs of small businesses; Novell now sells a stripped-down version of its network operating system

CONTINUES ON PAGE 32

Pipeline

by Gus Venditto

Sticker Shock At Upgrade Time

When the latest version of *Microsoft Word for Windows* shipped, Microsoft's forum on CompuServe was abuzz with the usual messages that surround new product releases.

There were impatient questions about when the packages would reach the stores. And there were outpourings of joy from those who found their prayers answered with the new version.

But there was also a lot of grumbling over the cost of upgrading from earlier versions. After years of paying $75 fees for upgrading their *Word* under DOS, many users were angry at the $129 price Microsoft placed on the *Word for Windows* 2.0 upgrade.

Many *Word for Windows* users had already upgraded from the DOS version for $150, a steep price that at the time seemed justified by the vast difference between a DOS program and a Windows program. But after paying the price for graduating to Windows, users didn't expect to keep shelling out.

This is only the beginning. It looks like Microsoft has started a trend once again.

The increase in upgrade prices is not a result of creeping inflation; it's a result of fundamental changes in the economics of the PC software business.

When more than eight or nine million new PCs were sold annually the installed base consisted of mostly new users, and the sales of software to first-time users was a booming business. Now, with more than 50 million PCs at work, selling upgrades to existing customers is more attractive than winning over new users.

The transition to Windows is likely to accelerate the trend, partly because software publishers are caught in a bind. They want to convert their customer base to Windows, yet they incur significant costs in writing the Windows version. Even for the smallest application, the cost of porting a program to the new environment can be several million dollars.

The wildly successful upgrade to DOS 5.0 fuels pricing strategies as well. The $99 *MS-DOS 5.0 Upgrade Kit* sold two million copies in its first five months on the market, and Microsoft expects to sell eight million more in 1992. In terms of gross sales and net profits, that makes DOS the most successful software upgrade campaign ever.

While there's a big difference between the marketing of an application and an operating system, the fact that Microsoft took the marketing of DOS upgrades away from PC makers is part of a campaign to build brand loyalty.

All large publishers are seriously at work on building loyalty. Lotus (which charges $150 for the upgrade from DOS versions of *1-2-3* to the Windows version) is working hard to sell its Windows products as a family, and it's the first publisher that has really had the chance to do that.

There may be no way to fight the high prices, but there can be benefits if you shop wisely. Upgrades are often sold in stores, creating a competitive situation for discounting.

Lotus's "double up" offer gives registered owners of any Lotus word processor or spreadsheet the opportunity to get both *Ami Pro* and *Lotus 1-2-3;* the retail price is $199 but I've seen it sold for $129.

And then there are the competitive upgrades, a concept that Borland pioneered with stunning success when *Quattro Pro* began its fight against Lotus for market share. Owners of *Word for Windows* can get a copy of *WordPerfect for Windows* for $150, instead of the $495 list price.

There may still be room to build a great application from ground zero, but the near future belongs to the upgrade. As one software executive recently put it, "Revving products is insanely profitable." He should know: he works at Microsoft. ■

THE RISING PRICE OF UPGRADES

Major upgrades for the two leading word processors have gotten more expensive over the last four years.

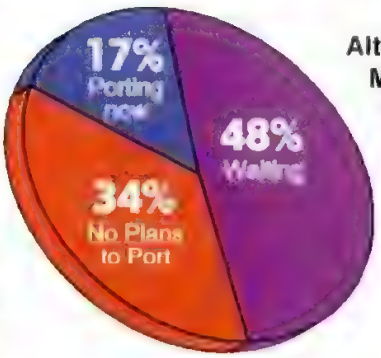
	1987–'88	'89	'90	'91
Microsoft Word	$75	$75	$150	$129
WordPerfect	$60	$75	*	$150

Note: Prices are for major upgrades; minor upgrades, which cost significantly less, are not shown. After 1989, the upgrades are for Windows versions.

*No major upgrade in 1990

Some Users Get Sneak Previews of Win 3.1 and OS/2 2.0

Reviews of Microsoft's Windows 3.1 and IBM's OS/2 2.0 won't be out until this spring when both products are scheduled to ship, but many users are already getting sneak previews. These customers are using versions of the operating systems that are nearly finished, say both companies.



Although Lotus, Novell, Micrografx, and WordPerfect are developing for OS/2 2.0, most Windows developers have no immediate plans to port their products.

Source: American Software Association, a division of ITAA

Microsoft says there are 8,500 customers in its Win 3.1 beta test program, which is expected to grow to 15,000 before the product ships; and IBM says 20,000 users have been involved in the OS/2 2.0 Early Experience Program. A small core group of these is expected to take advantage of December's limited availability release of 2.0, which lies somewhere between beta code and a finished product.

What's the difference between the Win 3.1 and OS/2 2.0 you can get today and the products that will be launched in a few months? Not much, says each vendor.

According to Microsoft, the feature set for Win 3.1 has been frozen since August, and most of the code has been set since October. The only difference between the beta and the shrink-wrapped product is that the latter will have fewer bugs and better compatability with hardware and software.

Microsoft, which learned the importance of thorough beta-testing when the bug-ridden DOS 4.0 (released under IBM's label) failed in the marketplace, believes that an operating system needs at least four months in the hands of users before it's ready for prime time. The company

Adobe's Carousel: The Fortified ASCII

Modern documents have outgrown ASCII file transfer; they can include text attributes, fonts, graphics, and even sound and video information—all of which are lost in ASCII transmission. Right now transmitting such an information-rich document requires that the recipient have an identical setup, down to the same fonts on their machine. (See Michael Miller's column in this issue.)

Adobe's proposed Carousel technology is a document interchange standard that's rich enough to handle today's documents. Based on PostScript, Adobe's page description language that is independent of device and resolution, Carousel could provide independence from applications as well.

Carousel's interchange standard would let you create a self-contained compound document with fonts and embedded graphics that could be sent, intact, to any other computer, including an Apple Macintosh or a NeXT machine. All you'd need on the receiving end is a "reader," where the document would look and print like the original. Past attempts at a comprehensive interchange format met with limited success. On the PC platform, IBM's Document Content Architecture (DCA) and Microsoft's Rich Text Format (RTF) are well known, but limited to the word processing paradigm.

In addition to extending the PostScript technology, Adobe's Multiple Masters font technology, announced in 1991, is a part of the plan. Multiple Masters can mimic the font metrics of the original document so the duplicate document can appear nearly identical without having the fonts on hand.—*Christopher Barr*

---

attributes the success of Windows 3.0, which has sold seven million copies, in part to its 3,500-participant beta program, and its success with DOS 5.0, which has sold two million copies, to its 7,500-person test drive. Participants in the Win 3.1 program will get free copies of the finished product.

IBM has gone beyond the testing stage and is already shipping a version of OS/2 2.0. But before you leap to the conclusion that IBM is ahead of Microsoft, keep in mind that the limited edition of OS/2 doesn't include some key features, such as the ability to run Windows applications in a window and a 32-bit graphics engine.

The limited availability idea is a new one for IBM. The December release lets IBM make good on its promise to ship OS/2 by the end of 1991. But delivering an unfinished product to an unspecified number of customers on the last day of the year may not be everybody's definition of a promise kept. IBM says some of its corporate customers are satisfied with the operating system in its current state and want to begin testing it.

Officially, the requirements to qualify for the limited availability program are pretty stiff: You have to commit to buying the operating system, which you will be billed for in March; you have to be buying the current version as part of your company's testing policy; and you have to devote a staffer to learning OS/2 (IBM will also provide you with an on-site OS/2 guru). But because the program is being handled by local branch offices, availability may vary. In Atlanta, bulletin board users report it's quite easy to qualify. Meanwhile, the rest of the world will have to wait until spring to see whether IBM or Microsoft will win the operating system wars.
—*Mary Kathleen Flynn*

Upcoming Operating Systems: Planned Features and Expected Delivery Dates

■ Yes ■ No

	OS/2 2.0	Windows 3.1	Windows NT
Scheduled release	March	Early spring	Late 1992
Runs DOS apps	■	■	■
Runs Windows apps	■*	■	■
Runs Presentation Manager apps	■	□	□**
Runs 32-bit Windows apps	□	□	■
Based on 32-bit code	Partly	Partly	■
Does task switching	■	■	■
Does preemptive multitasking	■	Partly	■
Protects one app from crashing another	■	Better than Win 3.0	■
Has built-in C2 level security	□	□	■
Supports dynamic data exchange (DDE)	■	■	■
Supports Object Linking and Embedding (OLE)	□	■	■

* With limitations, such as the lack of support for 386 Enhanced mode. And the December limited-availability release of OS/2 2.0 doesn't let you run Windows in a window; that capability has been promised for the March shrink-wrapped version

** Microsoft has said that later releases of Windows NT will support Presentation Manager apps; however, it is extremely unlikely that Microsoft would ever support PM's 32-bit graphics engine.

TOP 15 Software Sellers in Retail

RANK	COMPANY
1	**Quicken 5.0** Intuit
2	**WordPerfect 5.1** WordPerfect Corp.
3	**Microsoft DOS 5.0 Upgrade Kit** Microsoft Corp.
4	**QEMM-386 6.0** Quarterdeck Office Systems
5	**WordPerfect for Windows** WordPerfect Corp.
6	**DR DOS 6.0** Digital Research Inc.
7	**The Norton Utilities 6.01** Symantec Corp.
8	**Microsoft Windows 3.0** Microsoft Corp.
9	**Quattro Pro Special Edition** Borland International
10	**Lotus 1-2-3 2.3** Lotus Development Corp.
11	**Microsoft Word for Windows 2.0** Microsoft Corp.
12	**Quicken for Windows** Intuit
13	**ProComm Plus 2.0** Datastorm Technologies
14	**WordPerfect Network Station** WordPerfect Corp.
15	**Stacker 2.0** Stac Electronics

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending November 16, 1991. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market.

Sales information compiled by Ingram-Micro

BRIEFS

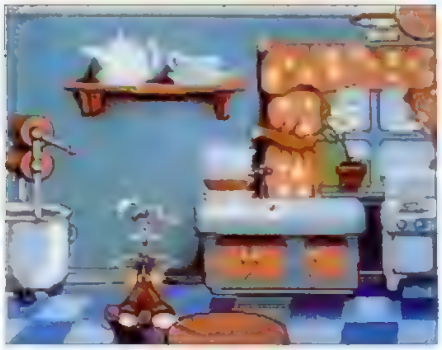
■ IBM, like Compaq, is considering selling mail order as it strives to increase the autonomy of the company's lines of business. Other moves in IBM's restructuring include reducing its work force by 20,000 employees through voluntary programs—that's in addition to the 20,000 encouraged to leave in 1991—and rearranging its management team. Robert LaBant is moving into George Conrades's old spot as general manager of IBM U.S., while Conrades becomes senior vice president of corporate marketing and services, a lower-profile position. IBM also picked up a new player: entrepreneur David Liddle. He was cofounder of Metaphor, IBM's former partner in object-oriented technology, which IBM recently acquired.

■ About face? The U.S. Air Force awarded CompuAdd and Sysorex Information Systems its Desktop IV contract, but then suspended it for 45 days after Apple, IBM, Zenith Data Systems, and others filed protests with the GSA (General Services Administration) Board of Contract Appeals. Twenty-two companies had bid on Desktop IV, which provides for a minimum of nearly $5 million and a maximum of approximately $1 billion for the purchase of up to 300,000 PCs over the next three years.

■ John Landry joins Lotus Development Corp. as chief technology officer, replacing Frank King. Formerly chief technology officer for Dun & Bradstreet Software, Landry is also president of the American Software Association.

■ Prodigy Services Co. is linking its on-line financial services with *Andrew Tobias's Managing Your Money*, MECA Software's personal finance package. The initial offering will allow users to buy and sell stock via Personal Control Financial Network (PCFN). Prodigy's on-line broker. Prodigy will download information from PCFN directly into *Managing Your Money*.

Disney and Phoenix To Provide $20 MPC Sound for Laptops



Sound Source, made for games like *Hare Raising Havoc*, will run MPC software.

The Sound Source is a $20 box that plugs into a PC's parallel port, generating sound effects and voice for games from Walt Disney Software.

Thanks to an agreement between Disney and Phoenix Technologies, laptops will soon be building the Sound Source logic onto their system boards to provide bare bones MPC (multimedia PC) audio.

Extensions to a new laptop BIOS from Phoenix will allow the Sound Source chip to work from DOS, and it will be compatible with the sound capability that Microsoft Corp. will add to Windows 3.1.

The Sound Source technology is a digital-to-analog conversion of compressed audio clips. While it generates comparatively low-fidelity, single-track quality, the output is well-suited to many office functions such as playing voice messages that are attached to data files on a network.

—*Gus Venditto*

Longer Lasting Notebooks to Use Lower Powered Parts

What's the best way to extend battery lif on a notebook PC? Other than urning it off, the answer is to ower the power requirements Advanced Micro Devices (AMD) is taking the lead by introducing a low-voltage 386 microprocessor that could double battery life.

AMD's 386 will operate at 3.3 volts, as opposed to an industry-standard 5 volts. The processor, an Am386LV, will be available in 20- and 25-MHz SX and 25-MHz DX flavors.

But a CPU running at 3.3 volts is just a part of the story. All components: memory, video controller, cache controller, ASICs, and peripherals (drive, display, and modem) have to run at the reduced power levels to achieve optimal savings.

A number of component manufacturers including Austek (cache controller), Cirrus Logic (VGA controller), Hitachi (memory), Micron (video DRAM), and Western Digital (I/O, system, peripheral controllers) have already begun making low-voltage parts.

Reduced-voltage systems have additional benefits, such as not requiring massive batteries. Also, lower voltage means reduced radio frequency interference and electromagnetic interference, which could translate into easier system design and reduced time-to-market for OEMs.

Computers using 3.3 and 5 volt parts, which would gain some power savings, are not possible until 3.3 volt floppy and hard disks, LCD panels, and modems are available. The first mixed-volt computers will be available by mid-year. Olivetti is the first vendor to announce products with the parts. The ultimate goal is a notebook with a 9-hour battery life by the end of 1992.—*Christopher Barr*

Compression Comes to the Chip Level

Stac Electronics, which sells both hardware and software for compressing hard disk files, has developed chips that put on-the-fly compression right on the system board of notebook and palmtop PCs. The Stac chip will effectively double the size of your hard disk by automatically compressing files when you write them to disk. The new chips are low-powered and turn off when not active.

ALR will be the first company to ship a product that will use the chip for hard disk compression. For about $100, it will be offered as an optional add-in board on ALR's VIP SL and M series upgradable notebooks.

The lossless compression algorithm (which means data is not eliminated as in JPEG video compression) developed by Stac Electronics is licensed by many OEMs. Stac estimates there are now more than a million tape drive manufacturers using their compression chips, and Stac's algorithm is also used reliably in *The Norton Backup* and *PC Tools Backup*. A review of Stac's *Stacker* and other compression programs is in this issue.

—*Christopher Barr*

LANs

CONTINUED FROM PAGE 29

called *NetWare Lite*, and Northgate recently began selling the Local Area Wireless Network (LAWN) through the mail-order channel.

Packard Bell's Integrated Network System includes a 486 file server; 3 to 25 of its 386SX workstations with 16-bit Ethernet cards; an 8-page-per-minute Packard Bell 9815 laser printer; an uninterruptible power supply; operating system software (DOS 5.0, Microsoft Windows, OS/2, and Microsoft LAN Manager); and applications, including *Microsoft Word for Windows*, *Excel*, and *cc:Mail*. More importantly, the system includes network wiring and installation, one year of on-site service, and 24-hour toll-free telephone technical support. Sold through Packard Bell retailers, such as Sears, a three-workstation network is expected to sell for approximately $14,500.

—*Mary Kathleen Flynn* ■

When you look at windows, it's not always clear what's behind them.

PC–mainframe software and a Windows interface is an ideal combination. After all, by making programs look similar, a graphical user interface makes them easier to learn and use.

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CIRCLE 353 ON READER SERVICE CARD

First Looks

Hands-on Reviews of the Latest Products

Harvard Draw for Windows: The Smoother Road To Business Drawing

HANDS ON
by Luisa Simone

Vector-based drawing programs such as *Micrografx Designer*, *CorelDRAW*, and *Arts and Letters Editor* have dominated the illustration market by trying to be all things to all users. These programs have had varying success in bridging the gap between professional artists and novice designers.

In contrast, Software Publishing Corp.'s newly released *Harvard Draw for Windows* takes a different tack and comes out squarely on the side of the business user. This $595 drawing program makes a point of simplifying both the tools and the dialog boxes—while still allowing you to create high-quality illustrations.

A prime example of this is the toolbox, which runs along the left side of the screen and contains 18 discrete functions. In addition to the standard selection of freehand, Bezier curve, skewing, mirror, and rotation tools, *Harvard Draw* contains a polygon tool that allows you to create multisided geometric shapes with a simple click-and-drag motion. This method requires a lot less work than drawing a series of line segments and then connecting the segments to close the object.

In the same way, the Pick Points tool (which allows you to change the shape of an object by controlling Bezier curves) will invoke one of two editing dialog boxes, depending upon whether you double-click on a node or on a line segment. Again, the program makes it easier for you to choose the right option by presenting you with only those functions you need at any par-

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Signature: XyWrite's Power Plus WYSIWYG Editing

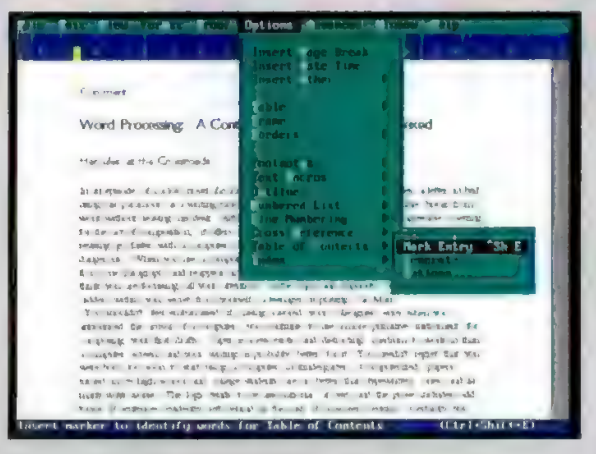
HANDS ON
by Edward Mendelson

Before Xyquest released its $495 *Signature* 1.0 word processor, you had to choose between programs with fast character-mode editing, such as *WordPerfect* and *XyWrite*, or programs with slow WYSIWYG editing such as *Ami Pro* or *Word for Windows*. *Signature*, a massively upgraded version of *XyWrite III Plus*, is both kinds of program's in one. Its character-mode editing screen looks like *XyWrite*'s, with an elaborate CUA-compliant menu. But one keystroke and a few seconds' delay switches the display to a graphical-editing screen that lets you create and edit files with the same zoomable realism that you get in Windows word processors.

XyWrite focused narrowly on fast editing; *Signature*, in contrast, is a full-fledged office application with mouse support, document summary screens, programmable merges, and document assembly from boilerplate text, plus warm links to database, spreadsheet, and text files. You can create links to files in every major format—a feature not otherwise available in DOS word processors—but the program can't automatically recognize other formats.

Xyquest wrote *Signature* under contract to IBM's Desktop Software Group, but when IBM disbanded the group before *Signature*'s release date, Xyquest regained marketing rights. The manuals have Xyquest stickers pasted over IBM's logo. $99 upgrades from *XyWrite* include a transition manual that's more accurate about the features it covers than the IBM-produced main manual.

CONTINUES ON PAGE 39



***Signature*'s optional WYSIWYG editing screen lets you edit in graphics mode, but its menus are the same as those in the character-mode screen. If you create a footnote with this menu, a character-mode editing window opens over the graphics-mode display.**

Harvard Draw

CONTINUED FROM PAGE 37

ticular moment.

You will find it easy to master *Harvard Draw*'s functions because they are so straightforward. For example, to customize a tool you merely double-click on its icon and then choose between one or two options associated with that function. You can set the number of sides in a polygon from 3 to 99, round the corners of a rectangle, and determine the corner sensitivity of the freehand stylus.

Special effects are equally direct. You can blend one shape into another; copy objects in circular, linear, or rectangular patterns; and align text to irregular paths via the simplest of dialog box options. To transform the overall shape of a Bitstream Speedo typeface (47 fonts come bundled with the program), you merely draw freehand or curved lines above and below the text and then choose the Shape Between Two Paths option in the Text Effects dialog box.

Harvard Draw can even create some nifty special effects with radial and gradient fills. The 12-pointed star and concentric boxes that form the patterns in the sample illustration below actually consist of simple squares with modified radial fills. The drawing takes advantage of the fact that *Harvard* allows you to assign a shape to a radial fill and also forces you to determine the number of steps in each color transition.

Unfortunately, the simple approach isn't always the best approach. For example, *Harvard Draw* will not skew or mirror text objects unless you first convert them to outlines. In addition, when you apply a text effect you'll find that *Harvard Draw* automatically converts the text to curves—making it impossible to edit the content of the text. More seriously, it does not allow you to fiddle with the effect. The only way to modify the transformation is to undo it and start over by drawing a new path. Compare this with *CorelDRAW*'s enveloping function or *Arts and Letters Editor* warp feature—which are easily modified and can be applied to both text and pictures.

There are also intrinsic limitations to the tools that cannot be ignored. For example, you can adjust kerning and intercharacter spacing, but only for entire text blocks; manipulating individual letter pairs must be done manually with the Pick Points tool. And the text effect alignment options don't work well with circles or arcs. The outlines of objects are limited to a width of 10 points. And though you can configure the line tool to automatically use an arrowhead line ending, you can only use a single arrowhead style per drawing. The tracing tool, which is very fast, allows you to control the density of points and the ratio of curves to corners. However, the inability to choose between outline and centerline tracing makes it difficult to accurately copy complex bitmapped images.

Surprisingly, the most ubiquitous of Windows conventions—the eight selection and scaling handles that surround graphical objects—have been replaced by corner brackets. In addition to ignoring the usability benefits of a standard interface, these brackets force you to employ a separate tool—and an extra mouse click—to resize objects.

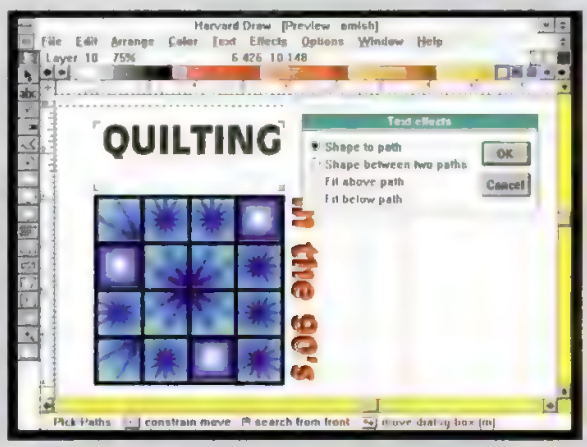
Although *Harvard Draw* isn't intended to go head to head with the technical illustration tools found in a program like *Micrografx Designer*, you can increase the precision of your drawings by automatically adding multiple guidelines to a page, employing the measurement tool, or using the coordinates dialog box (instead of the mouse) to create and position objects.

Harvard Draw does deserve kudos for its document management tools. You can lock individual objects to save them from inadvertent changes, or segregate different portions of a complex drawing on any of the 99 layers allowed by the program. Even if you decide to keep all of the elements of your drawing on a single layer, you can still organize them using Combine and Group. And because *Harvard* allows you to subselect the individual elements of a group, you can edit small portions of a complex drawing without tediously ungrouping and regrouping objects.

In addition, it is easy to access customized colors, radial, gradient, or pattern fills because a simple Ctrl-Shift-Click automatically adds them to the palette. And anyone who has ever wished he or she could get back an early iteration of a drawing will be grateful for the 16 user-defined levels of Undo.

Harvard Draw boasts fast performance times, speedy screen redraws (even in full-color preview mode), and quick PostScript printing. Performance aside, a big selling point for *Harvard Draw* may be that it offers limited file compatibility with the still popular (and still DOS-based) presentation program, *Harvard Graphics*. *Harvard Draw* can import and export *Harvard Graphics* .CH3 and .SY3 files, in addition to industry standard formats such as .CGM, .TIF, .EPS, .PCX, and .WMF. You'll have plenty of opportunities to test out *Harvard Draw*'s file import functions, because the program comes bundled with 1,000 pieces of clip art from well-known companies such as 3G Graphics and Image Club.

In the final analysis, there is no denying that Software Publishing Corp.'s *Harvard Draw* offers fewer functions than other Windows-based illustration programs. It will only succeed if it can convince business users that in software (as in art) "less is more." And that by simplifying the tool set, *Harvard Draw* not only becomes more affordable (it costs $100 less than its competition), but is also easier to learn and faster to use. ■



Special effects are easy to create with *Harvard Draw*. For example, the patterns in the quilt were all created by controlling the radial fill options. The self-explanatory options in the Text Effects dialog box can automatically align the selected headline to the curved path. Notice that the selection brackets, in lieu of handles, are not standard Windows fare.

FACT FILE

Harvard Draw for Windows
Software Publishing Corp., 3165 Kifer Rd., Santa Clara, CA 95051; 408-986-8000.
List Price: $595.
Requires: 286-based PC or better, 2MB RAM, 10MB hard disk space, EGA graphics adapter or better, mouse, DOS 3.0 or later, Windows 3.0 or later.
In Short: *Harvard Draw* offers business users self-explanatory dialog boxes, configurable tools, fast performance, and high-quality output. Although it doesn't offer the technical sophistication or the special effects of its competitors, it lists for $100 less.

CIRCLE 710 ON READER SERVICE CARD

Signature

CONTINUED FROM PAGE 37

IBM planned to offer *Signature* as an upgrade for *DisplayWrite*, for it works almost transparently with *DisplayWrite* files. *DisplayWrite* users can upgrade for $119. *Signature* beginners and *DisplayWrite* veterans can use *Signature*'s menu; *XyWrite* veterans can work from the command line, which now cycles through previous commands. You can switch between the menu and command line with a keystroke.

Signature retains most of *XyWrite*'s speed and increases its staggering range of customization and format options. But *Signature*'s IBM-style spell-checker works at less than one-third the speed of the *XyWrite* spell-checker, and search and replace operates at less than half of *XyWrite*'s speed.

The new menu is designed to help beginners, but it doesn't shield them from the complexities of a program that can be tamed only by expert use of the command line. Some menu items are actively misleading. The Endnotes menu lets you choose the bottom of the file as the location for the notes, but if you choose this option when your file is 10 pages long and then add another 20 pages, your endnotes will print on page 10. You can only fix this if you know enough to search and remove an embedded marker with the code letters DF (for Dump Footnotes).

Don't expect Undelete to undo a deletion you perform with the Delete or Backspace keys; it will either display the puzzling message, "There is no macro assigned to key," or restore an earlier deletion performed with some other key.

The whole interface is plagued with inconsistencies. The mouse works in most menus but not all. Some lists take you back to the top of the list when you scroll to the bottom; others don't. If you delete a code used when linking text, the mere presence in your file of a related code causes error messages that plague you until you find and delete it.

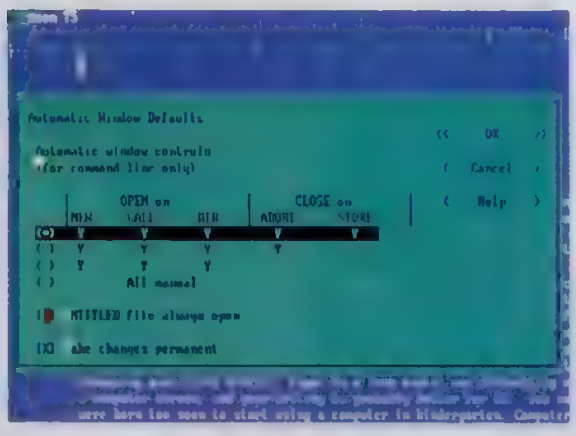
Signature imports .PCX, TIFF, and .PCL graphics files and displays them in WYSIWYG mode, but its graphical support doesn't match *WordPerfect*'s or any Windows word processor. You have to convert compressed TIFF and other formats from a menu and wait three minutes while *Signature* converts files that other programs import in seconds. For equation editing, get K-Talk's $199 *MathEdit* (614-294-3535), which attaches to the menu.

You can use menus (not the mouse) to position images, but if you want to modify the values you entered in the menu you have to edit an obscure embedded code. As in *XyWrite*, the syntax for editing an existing code differs from the syntax for entering the code initially—and both syntaxes sometimes scarcely resemble the options displayed on the menu.

The default display mode wastes screen space on the blank left margin. To shift text to the left edge of the screen you have to switch to Draft View Without Page Breaks—a secret you won't learn from the manual or help screens. When you switch to graphics view you see headers and footnotes in place, but you can only create or modify headers and footnotes in a command window that uses character-mode screen fonts instead of the WYSIWYG fonts on the rest of the screen.

Signature uses Bitstream's scalable Speedo fonts for its graphics display and optionally for printing. The package comes with Bitstream's versions of Times, Helvetica, and Courier; other Speedo fonts on your disk load automatically. You can install LaserJet cartridges and soft fonts, but you can't use PostScript soft fonts until the next release. Speedo fonts let you print over 500 characters; 300 more will print if your fonts support them.

Powerful as it is, *Signature* feels awkward and unfinished and only partly succeeds in integrating its menu and command line interfaces. But you won't find another character-based program that also offers WYSIWYG editing, and you won't find any word processor as customizable as *Signature*. It's often raw, but it's always powerful. ■



Typical of *Signature*'s customizing options are the range of choices for deciding what to do with windows when you perform basic file operations.

SIGNATURE: Should You Upgrade?

Signature won't tempt users away from *WordPerfect* or *Microsoft Word*, but it offers a clear upgrade path from both *XyWrite III Plus* and *DisplayWrite*.

Advantages for *XyWrite* users: Command stack so you don't have to retype commands; easier recorded macros and enhanced macro language and search options; vastly superior font support and WYSIWYG editing.

Disadvantages for *XyWrite* users: Brand new keyboard layout to learn; slower word search and speller; requires too much disk space for laptops; custom menus and keyboards must be rewritten.

Advantages for *DisplayWrite* users: Absolutely effortless exchange of files with mainframe *DisplayWrite*; more compatible printer support and more familiar procedures than is now possible with other current advanced word processors; vastly improved speed and flexibility.

Disadvantages for *DisplayWrite* users: Completely new keyboard to learn; no conversion of *DisplayWrite* macros, and some macro programming needed to perform functions that *DisplayWrite* can record.

—*EM*

FACT FILE

***Signature*, Version 1.0**
Xyquest Inc. 44 Manning Rd., Billerica, MA 01821; 508-671-0888
List Price: $495; upgrade from *XyWrite*, $99; from *DisplayWrite*, $119; from comparable word processors, $129
Requires: 384K RAM (512K recommended); 3MB to 11MB disk space depending on configuration.
In Short: *Signature* is bigger and slower than *XyWrite*, but it increases *XyWrite*'s raw-edged power.

CIRCLE 706 ON READER SERVICE CARD

HP's DeskJet 500C: "C" Is For Cost-Effective Color

HANDS ON
by Alfred Poor

Windows 3.0 has changed the face of computing, but one area has lagged behind: printing. We expect to see low-cost high-resolution color on our monitors, but we settle for black-and-white printouts. Or at least we did, until the arrival of Hewlett-Packard's HP DeskJet 500C.

With a list price of $1,095 and 300-dot-per-inch resolution, the HP DeskJet 500C breaks new ground in terms of printed color output. Thermal wax transfer page printers still give better output but cost between $5,000 and $10,000 or more. And dot matrix printers have offered color output options at affordable prices for years, but the quality leaves much to be desired, and few people remain satisfied with the text output quality of most dot matrix printers.

The HP DeskJet 500C does an excellent job with text, as might be expected since it is derived directly from the Editors' Choice HP DeskJet 500 ink jet printer (*PC Magazine*, November 13, 1990, page 290). In portrait mode you have access to two monospace fonts (Courier and Letter Gothic) in various point sizes, and proportional CG Times in 6 and 12 points. All fonts can be printed in upright or italic and in medium or boldface. (Only the Courier fonts are available for landscape printing.)

With a black ink cartridge installed, you get the same quality of output you would get on a HP DeskJet 500. HP rates the black ink cartridge for 500 pages, which works out to $0.04 per page at the list price of $19.95 per cartridge—a bit higher than most laser printers. (HP has announced a high-capacity black cartridge with a list price of $31.95, scheduled to start shipping early in 1992.)

The black cartridge can be snapped out, placed in a protective case, and replaced with a color cartridge. The three-chamber color cartridge contains magenta, cyan, and yellow inks, which can be combined to produce just about any color you want. The HP DeskJet 500C uses built-in dithering capabilities to produce a nearly unlimited range of colors.

To use the color capabilities, you need an application that recognizes the printer. Thanks to its Windows driver, the HP DeskJet 500C can offer support for hundreds of Windows programs. There are also drivers for certain DOS applications, including *Lotus 1-2-3*, *Harvard Graphics*, *Quattro Pro*, and HP's *Graphics Gallery*.

The Windows driver lets you make many different selections, such as color versus black only, output quality, and level of color saturation. The quality levels and print speed are interrelated; normal quality produces some horizontal banding; presentation mode removes most banding but takes longer to print. There are also different dithering patterns that you can select, including a random scatter pattern that works well for continuous-tone images such as photographs. (The dither patterns are available for both color and black-only modes.)

The Windows driver also offers the advantage of scalable font support, including three Intellifont outlines: Courier, CG Times, and Univers. Unlike most print drivers under Windows, this driver does not run through Print Manager. Instead, you lose control of your computer during printing, and a window appears that keeps you posted on the status of the output. As a result, you will typically want to use the lowest resolution and the simplest color to speed the printing process.

Our tests show that the difference in graphics print times can be considerable. We printed a 2-inch-square image of a scanned photograph on the center of a standard sheet of paper. Using the application's halftone dithering with the black cartridge, printing took 16.8 seconds in normal mode and 26.1 seconds in presentation mode. Using the black cartridge and the random-scattering dithering pattern in the Windows driver, the same image took about 53 seconds in both normal and presentation modes.

When we replaced the black cartridge with the three-color cartridge, the print time shot up to 81.6 seconds in normal mode and 94.8 seconds in presentation mode. Since the color cartridge has only magenta, yellow, and cyan inks, it must combine all three to create a black image; the result has a dark olive-green tinge to it but should be suitable for most applications.

For text speed, the HP DeskJet 500C turned in a timing similar to that produced by the HP DeskJet 500: 2.6 pages per minute in quality print mode with the black-only cartridge.

A color version of the economical DeskJet, the HP DeskJet 500C produces full color at 300 dpi at $1,095.

PHOTOGRAPHY: THOM O'CONNOR

FACT FILE

HP DeskJet 500C
Hewlett-Packard Co., 19310 Prunerdge Ave., Cupertino, CA 95014, 800-752-0900.
List Price: $1,095.
Requires: IBM PC or compatible with parallel or serial port.
In Short: The HP DeskJet 500C is a breakthrough product that brings high-quality text and affordable 300-dpi color output to the PC market and to Windows users in particular. It fills an important gap between impact dot-matrix printers and high-end thermal wax transfer page printers.

CIRCLE 702 ON READER SERVICE CARD

Unlike some older ink jet models, the HP DeskJet 500C is a snap to set up and maintain. The ink cartridges snap in and out in such a way that it's nearly impossible to spill ink or get it on your hands or clothing. The cartridges also contain the ink nozzles, so you get a fresh set of nozzles every time you change the cartridge.

The HP DeskJet 500C comes with both parallel and serial ports configured to "plug and play." If you use the serial port, you may need to change some of the factory-default switch settings to change the baud rate. In case you have any questions, the printer comes with a series of manuals that explain setup and operation in detail, with plenty of useful illustrations. There is also a separate booklet devoted to using color effectively in your work.

HP hasn't forgotten users of earlier DeskJet models, either. If you have an HP DeskJet 500, you can get a factory upgrade for $450; DeskJet and DeskJet Plus models can be upgraded for $550. Existing DeskJet font cartridges will work fine in the 500C.

If you're in the market for a printer that produces near-laser-quality output but can also print color when you need it, the HP DeskJet 500C looks like your best bet. Now you can have color graphics output to complete your Windows system. ■

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† Contact QMS for availability of network options

*Patent pending

Borland Asserts Leadership with a Trio Of New C++ Compilers

HANDS ON
by Kaleb Chatterjee

Borland International is aggressively asserting its leadership in the object-oriented fracas with three new versions of its popular C and C++ compilers. For low-cost Windows programming there is Turbo C++ 3.0 for Windows, a completely new product. Borland's Turbo C++ for Windows is comparable with Microsoft's recently released Quick C for Windows, although there are important differences that will be discussed below.

The second-tier product is Borland C++ 3.0, which is a major revision of Borland's 2.0 C++ compiler. Borland C++ 3.0 supports both DOS and Windows programming and includes Borland's new optimization technology.

The high end of Borland's C++ product line is Borland C++ 3.0 with Application Frameworks. This is Borland's C++ 3.0 product combined with its comprehensive class libraries.

All three of the above products include Borland's Resource Workshop, which is a Windows program that helps you create menus, dialog boxes, and other graphical elements for Windows. Resource Workshop has previously been available separately for $49.95 but will soon be phased out as a separate product. Also, all three compilers implement revision 2.1 of the C++ language. Thus all three are one step ahead of Turbo C++ for DOS, which implements only Version 2.0 of the C++ spec and is due for an upgrade.

TURBO C++ 3.0 FOR WINDOWS

When Borland International first introduced a Windows-capable compiler in early 1991, most users were completely shocked that it didn't include a Windows-hosted programming environment. That obvious shortcoming has been addressed with the release of Turbo C++ 3.0 for Windows, which will be instantly familiar to people who have used Borland's DOS version of Turbo C++.

The main changes from the earlier version are the new Windows-hosted programming environment, the replacement of Whitewater's Resource Toolkit with Borland's Resource Workshop, and the new Turbo pricing ($149).

Turbo C++ for Windows is a lot more than just a C and C++ compiler; it contains both a complete set of tools and libraries for Windows programming. This means that you are not required to purchase Microsoft's SDK to develop Windows applications with Turbo C++ for Windows.

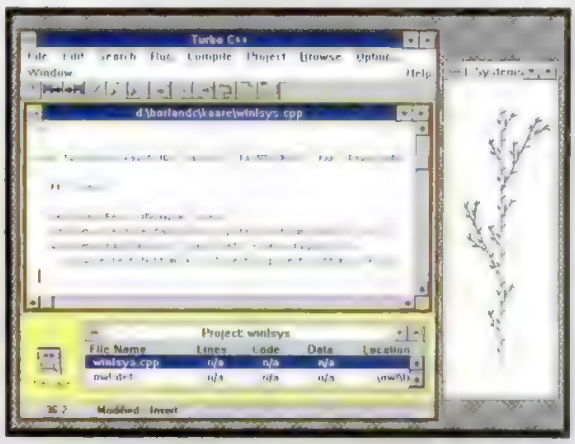
In the tools category are Borland's TDW windows debugger, its Resource Workshop for designing the visuals, and both Microsoft's resource compiler and help compiler. The libraries include EasyWin, for porting DOS character applications to Windows, and Borland's ObjectWindows class library, which takes a good deal of the sting out of Windows development.

Turbo C++ for Windows doesn't contain printed references for the Windows function library or the C runtime library. However, in all likelihood most users would agree with Borland's skimping on the manuals to keep the price down; both libraries are fully detailed in Borland's excellent on-line help. And two final caveats: Borland C++ for Windows doesn't contain a command line compiler, and it isn't capable of compiling an ordinary DOS application.

Turbo C++ for Windows' main competitor is Microsoft's Quick C for Windows (First Looks, November 26, 1991). Both products feature easy-to-use Windows-hosted environments, and both lack the optimizers that are found in their more expensive siblings. If C++ is your chosen language, then Borland's product is the only choice.

However, Microsoft's Quick C for Windows has some advantages. Its QuickCASE:W tool is more powerful than Borland's Resource Workshop because it can generate your user-interface Windows code, and Microsoft's project-management facility is more comprehensive than Borland's. Finally, the integration of the Microsoft tools, although flawed, is clearly superior to the integration of Borland's tools.

Still, price, comprehensiveness, and a Windows-hosted environment make Turbo C++ another breakthrough for Windows development.



Turbo C++ for Windows is a svelt programming environment. Below the icon bar is the code for the WM_Paint class number function which draws the graphic.

BORLAND C++ 3.0

Borland C++ 3.0 is designed and priced ($495) for the professional developer. It contains three separate compilers: a DOS command line compiler, a DOS integrated environment, and the Windows-hosted environment from Turbo C++ for Windows. All three compilers are capable of generating Windows applications, but only the two DOS versions can do so using the optimizer. Borland C++ 3.0 doesn't contain a printed Windows function reference, which is a bit disappointing in a $495 product. Otherwise, the documentation is comprehensive.

Borland C++ 3.0 continues to include Turbo Assembler, Turbo Profiler, and Turbo Debuggers for both DOS and Windows.

Many people are disappointed that $495 Borland C++ lacks the ObjectWindows library that is supplied in the $149 Turbo C++ for Windows compiler, and that it also lacks the Turbo Vision library that is supplied with the $199 Turbo C++ and Turbo Vision bundle. The strong implication here is that Borland is charging $300 to $400 for its optimization technology, which is the main advantage of the Borland C++ product over its Turbo cousins. A kinder and gentler pricing scheme would be preferable; the current approach renders the mid-level product unattractive to users of the Borland class libraries.

It's also disappointing that Borland C++'s Windows-hosted development environment is literally borrowed from Turbo C++ for Windows. That means that none of the advanced Borland C++ 3.0 compilation options are accessible from the Windows-hosted programming

CONTINUES ON PAGE 44

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*patent pending

CIRCLE 164 ON READER SERVICE CARD

BORLAND

CONTINUED FROM PAGE 42

environment. In a professional Windows programming system you shouldn't have to shell out to DOS to build an optimized Windows application.

All of Borland C++'s DOS executables are actually DOS-extended applications. This is a good thing because it means these tools are not fenced in by DOS's 640K limit. But if you need DOS-extender capability for your own software you'll have to look elsewhere, because Borland doesn't provide the tools to build your own DOS-extended application. And just for the record, Borland C++ 3.0 does not contain any 32-bit capabilities, and it cannot build OS/2 applications.

BORLAND C++ 3.0 AND APPLICATION FRAMEWORKS

Borland C++ 3.0 and Application Frameworks (BC&AF) is, at 16 pounds, the heaviest C compiler we've ever encountered. It comes in a cardboard suitcase equipped with a plastic carrying handle and a prominent warning: heavy carton, handle with care!

The mammoth BC&AF consists of everything in Borland C++, plus Borland's ObjectWindows and Turbo Vision class libraries and source code for all of the libraries.

Remember DOS's old 33MB size limit for a single disk volume? Don't even consider the possibility of installing BC&AF on such a volume; you need 48MB for a full installation, and it is difficult to reduce that by pruning the features you don't need.

ObjectWindows is a C++ class library for creating Windows applications. It is a light wrapper for Windows; it makes some aspects of Windows development more convenient but still makes it easy to insert native Windows calls where necessary.

ObjectWindows' biggest innovation is the elimination of Windows' infamous message switch statements; instead, each message is handled by a C++ class member function. This is a simpler, cleaner approach that should be welcomed by everyone who uses Windows. The only drawback is that Borland has extended the C++ syntax to implement this, which makes ObjectWindows applications nonportable to other C++ compilers.

Turbo Vision started as a Turbo Pascal Professional class library. Its new C++ incarnation makes it easy to create DOS applications that contain a slick, windowed, mouse-driven user interface. Although Turbo Vision can be extended to create your own look and feel, by default it produces applications that look much like Borland's Turbo product line.

Application Frameworks also contains a Container class library, which is used to create classic data structures such as lists, queues, and strings. All three, ObjectWindows, TurboVision, and the Container class libraries, are quite excellent; they demonstrate perfectly the value of the object-oriented paradigm.

It's very easy to be more enthusiastic about Borland C++ with Application Frameworks than the plain, unadorned Borland C++. The whole idea behind object-oriented programming is to simplify your own job by taking advantage of existing class libraries. Borland C++ by itself is like a good French dinner without the wine. ■

List Price: Turbo C++ for Windows, $149.95. **Requires**: 2MB extended memory, 6MB hard disk space, Microsoft Windows 3.0. **List Price**: Borland C++ 3.0, $495. **Requires**: For DOS development: 286-based PC or better with 1MB extended memory. For Windows development: 2MB extended memory, 10MB hard disk space (30MB for full installation), Microsoft Windows 3.0. **List Price**: Borland C++ and Application Frameworks 3.0, $749. **Requires**: As above (48MB hard disk space for full installation).
Borland International Inc., 1800 Green Hills Rd., Scotts Valley, CA 95067-0001; 408-438-5300.

CIRCLE 704 ON READER SERVICE CARD

BORLAND'S NEW OPTIMIZER

The first ten commandments for a C compiler are all the same: Generate correct machine language code. Only when those challenging commandments have been obeyed can a compiler attend to the more elusive goal of generating the most efficient code. A good compiler must optimize—that is, rework the literal translation so that its meaning is preserved while its efficiency is improved.

Previous Borland C compilers paid not enough attention to code optimization, but in the current release the optimizer has been completely reworked and the results are generally pretty good. There are multiple options that let you enable and disable specific optimizations, which in turn allows you to tune the optimizer to meet all of your needs.

Part of my testing was to compile programs with and without optimization and measure the speed difference. I usually noticed about a 10 percent reduction in test timings using the optimizer, which is a very respectable result. Since Borland C 3.0 is somewhat faster than 2.0 even without the optimize, upgrading is definitely recommended.

Many people are curious about how Borland's new optimizer compares with more mature optimizers, such as those in Zortech C++ or in the forthcoming Microsoft C, Version 7.0. In a word, close. Borland hasn't passed these two rugged code generators, but they have considerably narrowed the gap.

In my testing using the standard Dhrystone benchmark test, which is a good measure of a compiler's overall performance, Zortech just edged out Borland, with Microsoft C 7.0 (still in beta) taking the lead. However, the speed differences are small enough that one should choose between these products based on functionality, not optimization.

Can optimization ever hurt? That's not the desired result, but it is possible. Optimization is a code rearrangement, meant to shave a microsecond here and another one there, aiming at a net speedup. Optimization decisions can be like business decisions: Sometimes you have to spend time to make time. And sometimes there just isn't any payback.

In a very close examination of Borland's optimized code, I noticed one optimization, intrinsic function in-lining that looked shaky. The idea of intrinsic in-lining is to save the time of a subroutine call by putting the body of a short, important routine right where it is needed. Although intrinsic in-lining sounds good, I was easily able to write a small, hard-nosed program that ran slower when optimized. The moral, I guess, is be suspicious of any optimizer.

The most common improvement that I observed in Borland's optimized code was better use of the processor's registers. This is important and welcome, and it accounts for much of the speed improvement. But on the downside, there are also times when Borland's optimizer either fails to make needed improvements or even manages to make things a bit worse. Yes, these are the exceptions, but I'd prefer an optimizer that didn't need me looking over its shoulder.—*KC*

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CIRCLE 175 ON READER SERVICE CARD

First Looks

AceFile: A DBMS for Everyday Work Comes to Windows

HANDS ON
by Jonathan Mauker

Windows 3.0 has been a resounding success, but Microsoft's graphical interface still suffers from a lack of third-party application support in several critical categories. Database management is a particularly glaring example of this software vacuum.

Microsoft has been promising a home-grown Windows database on an annual basis, and it looks as though *Cirrus*, as it's called, will be available sometime in 1992. At least two Windows-based relational DBMSs (database management system) Blyth Software's *Omnis 5* and Precision's *Superbase 4*-already meet the needs of developers and high-end users, but Windows users with more modest requirements have been out of luck.

Ace Software's modestly priced ($295) *AceFile* not only takes liberal advantage of the power and amenities available under Windows, but also offers surprisingly sophisticated database functionality for users with relatively modest personal database management needs. *AceFile* doesn't provide the programmability or SQL functionality of high-end DBMSs, but it has power to spare for tasks formerly handled by flat-file or simple relational programs under DOS.

Users should be able to meet just about any personal data management need with *AceFile*'s support for up to 2 billion records per database. Each record supports as many as 128 fields (or a total of 4,096 characters per record), according to Ace Software. Records can contain a single memo field of up to 5,120 characters in length; memo fields are stored in separate disk-based files, as are database index files. Up to 10 *AceFile* databases can be open simultaneously, and relational links can be established between tables via look-up tables. DDE support is included.

The default view of your data when you open an *AceFile* database is a familiar tabular layout, with each record represented as a single line of the table. A "form view" displays each record individually; you can step through the records using the keyboard or by clicking on mouse buttons. *AceFile* easily generates cross-tab views and can display your cross-tabulated data in a variety of graph formats, including area, pie, line, and bar charts.

AceFile takes terrific advantage of Windows' multiwindow capabilities by letting you associate so-called "view sets" with your database files. You can, for example, define a set that includes a list view, a form view, and a graphical representation of your data. All three are displayed in separate windows. As you browse through the table or form view, the other views are updated to reflect your position in the database. So if you browse to a particular record in the form view, *AceFile* automatically highlights the corresponding line in the tabular or "list" view.

Generating a database template under *AceFile* is a blessedly simple undertaking, accomplished from within the "Create Database Structure" dialog box. You name the individual fields and select a data type and field length for each one. Once the structure of your database is defined, *AceFile* prompts you to enter data and pops up a form view of your structure, ready to receive data.

AceFile directly reads and writes .DBF files, which should be quite helpful to users who aren't database gurus but who need to import and work with files generated by other, perhaps more elaborate software. Besides *dBASE* support, *AceFile* offers flexible file conversion, importing files in .WKS, .WK1, .WR1, fixed-length, and delimited text formats.

AceFile's report generator has some fairly impressive text and data manipulation capabilities, including mail-merge, but it imposes some limitations on the user. A report page is arbitrarily divided into several sections such as "header title," "body," and "footer." Text is placed within a report after you first define rectangular text boxes that the documentation mysteriously refers to as "objects."

Vague and disorganized documentation is *AceFile*'s biggest shortcoming. The tutorial has several outright errors and is missing several key paragraphs in the section on report generation. This is simply not acceptable in a product aimed at busy users who don't have the time or the inclination to spend weeks learning a software package. Ace Software reports that the manual is already undergoing a substantial revision.

Other complaints are relatively minor. A dialog box provides a simple way to generate filter expressions in *dBASE* syntax, and a "check expression" button checks its validity. But that's as far as it goes; you are informed whether the expression is okay or not, but there are no explicit error messages. If you abort in the middle of recording a macro using *AceFile*'s simple keystroke recorder, the program not only ditches the macro but also stores the current file. To take another crack at the macro, you must reopen the file. And there is no indication of which index files are open at a given time; you have to keep track of that yourself.

AceFile is an easy-to-use, powerful, and flexible route to data management under Windows. Besides a few questionable (and minor) design decisions, it offers the nonspecialist an effective weapon in the war against disorganized information. If Ace Software follows through on its promise to rework the documentation, future competitors in this potentially large category will have a tough example to live up to. ■

***AceFile* exploits the Windows environment by allowing you to open several linked windows. Here the same .DBF file is displayed in tabular and form views.**

FACT FILE

AceFile
Ace Software Corp., 1740 Technology Dr., #680, San Jose, CA 95110; 800-345-3223, 408-437-3456.
List Price: $295.
Requires: 286-based PC or better; 2MB RAM; 3MB hard disk space; Windows 3.0.
In Short: A truly easy-to-use Windows database for everyday use by nonspecialists. A few rough edges in the interface need to be smoothed out, and the documentation needs to be reworked.

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CIRCLE 313 ON READER SERVICE CARD

ObjectVision 2.0 Improves on Groundbreaking Database Design Tool

HANDS ON by Ray Duncan

ObjectVision, Version 2.0, is a textbook example of how much a product can be improved by a company that strives for excellence and listens carefully to its customers—even in the absence of competition. (For a review of *ObjectVision* 1.0, see First Looks, February 26, 1991.)

The product is an interactive development environment for Windows data entry applications, an object-based form management tool, and a database front end. Yet the sum of those parts still doesn't convey the product's distinctive nature.

Applications are composed of forms drawn directly on-screen and controlled by "decision trees" that are also designed visually. Creating an application does not require programming experience. Indeed, *ObjectVision* doesn't even have a programming language in any traditional sense.

ObjectVision has two operating modes: Form Completion Mode and Design Mode. The Form Completion Mode is the only mode seen by an end user of an *ObjectVision* app. When the user launches the application and fills in the fields in the on-screen form, a cascade of actions may result: Other fields can take on values that are calculated or fetched from a database, the entered data may be stored in a database, and new forms may appear on screen depending on the entered, calculated, or looked-up field values. The forms may also activate other Windows apps and pass data to them or request data from them via Windows' dynamic data exchange (DDE).

In Design Mode, *ObjectVision* seems, at first glance, very similar to Visual Basic or Asymetrix's *ToolBook*. Forms are designed visually by direct manipulation: Buttons, legends, graphical decorations, data entry fields, and other objects are positioned and resized on the form by clicking and dragging with the mouse. You can link multiple forms in the same application and load them only when needed. But that's where the resemblance ends.

To make a form "smart" in Visual Basic or *ToolBook*, you must write procedural programs that are attached to a form's objects and control their actions. In *ObjectVision*, you merely employ a visual editor to build a flowchart that specifies how a particular object should react to a field's value or other event. Each decision point or endpoint in the flowchart can use or set the value of any field in the application, and can perform calculations with the aid of *ObjectVision*'s extensive repertoire of "@" functions.

ObjectVision's database capabilities are similarly unchallenged by Visual Basic or *ToolBook*. It understands and can directly access or update full-fledged, indexed relational databases that have standard *dBASE*, *Paradox*, or BTrieve structures. Associating a field in an *ObjectVision* form with a field in a database is as simple as supplying *ObjectVision* with the name of the database file and then picking the proper field from a list. Fields can retrieve or send data via DDE in a similarly simple manner.

In contrast, Visual Basic cannot access databases without the aid of third-party libraries, and *ToolBook*'s built-in flat-file database is suitable for only the most modest of applications.

The improvements in *ObjectVision* are too many to list in detail. The nicest new features are encountered during form design. In Version 1.0, the creation and positioning of objects within forms and the design of decision trees was a tedious job requiring many mouse clicks and menu selections. This process has been streamlined; objects such as buttons and fields are picked from a toolbar and dropped into position with the aid of a ruler and grid. A new Property Inspector allows you to click the right mouse button on any button, field, or other form component to change its font, color, or other characteristics. It also provides access to the object's decision tree. (The clumsy Tree Editor has been eliminated.)

Decision trees have been generalized, too. They can now be hooked to any type of form object instead of just to buttons and fields, and can be activated by hotkeys, form loading, and other events in addition to button clicks and field completions.

Other enhancements are likewise aimed at the application developer. Several new types of form objects are supported, including true radio buttons, combo-boxes, and multiline/multicolumn tables. The library of @ functions has been expanded with 92 additions, and functions in external dynamic link libraries (DLLs) can now be called directly from an *ObjectVision* application as long as the DLLs are compatible with *Excel* calling conventions.

Password protection and support for Microsoft's new object linking and embedding (OLE) protocol have been added. But the nicest new feature is the runtime for turnkey *ObjectVision* applications, which is now included in the basic retail package at no added charge.

Companies talk of object-oriented software and use object-oriented terms as marketing weapons, but Borland is making object-oriented technology deliver on its promises. *ObjectVision* 2.0 is a significant step forward for an important product, and it blazes the path for a whole new category of application development tools. ■

ObjectVision 2.0 supports several new types of screen objects—radio buttons, combo boxes, and tables—and makes their placement and customization much easier with its new toolbar and Property Inspector.

FACT FILE

***ObjectVision*, Version 2.0**
Borland International Inc., 1800 Green Hills Rd., Scotts Valley, CA 95067; 800-331-0877, 408-438-5300
List Price: $149.95; update from Version 1.0, $49.95.
Requires: 286-based PC or better, 1MB RAM, 2.5MB hard disk space, graphics adapter, DOS 3.1 or later, Microsoft Windows 3.x.
In Short: An innovative, visual application generator for Windows 3.x. Easily integrated with existing *Paradox*, *dBASE*, or BTrieve applications and databases. Supports dynamic data exchange (DDE) and object linking and embedding (OLE).

CIRCLE 700 ON READER SERVICE CARD

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"What's most meaningful about these awards," said Gateway 2000 President Ted Waitt, "is they are given by the readers of

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Computer Shopper, people who are buying and using PCs in the real world."

Shopper readers voted in record numbers: 15,000 people cast over 100,000 votes for products in 27 hardware and software categories. The vote on desktop PCs was a decisive victory for the Midwestern firm customers call the "cow company."

According to *Computer Shopper*, the Best

ees from departments throughout the company.

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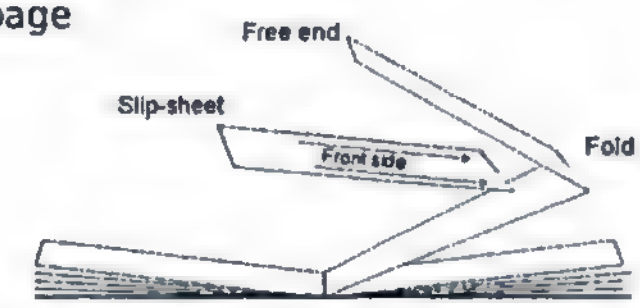
GbsSlipSheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

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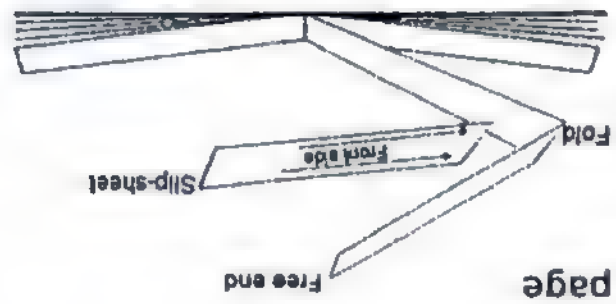
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



GbsSlipBack-0018

Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

For the first time in the six-year history of *Computer Shopper* magazine's Best Buy competition, one company swept all of the awards in the desktop PC categories. At COMDEX/Fall '91 in Las Vegas, Gateway 2000 was awarded Best Buy honors for 286, 386SX, 386 and 486 desktop computer systems.

Our thanks to Gateway's own Semi-Gold Dancers played by employ

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Foldout slip-sheet

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2. Insert this sheet with
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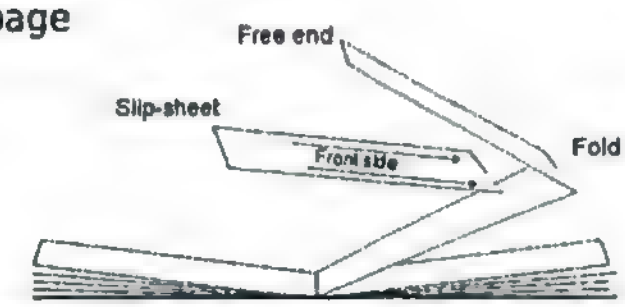

Inverted Foldout slip-sheet

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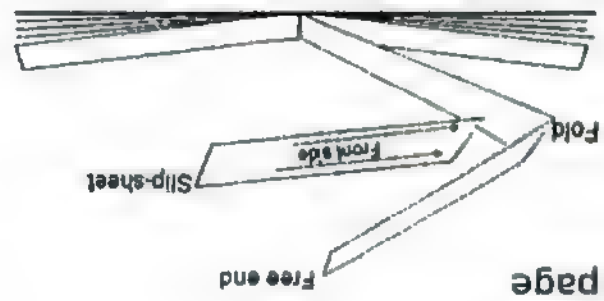
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



GbsSlipBack-0018

Back

1. Follow instructions on the other side

Inverted Back

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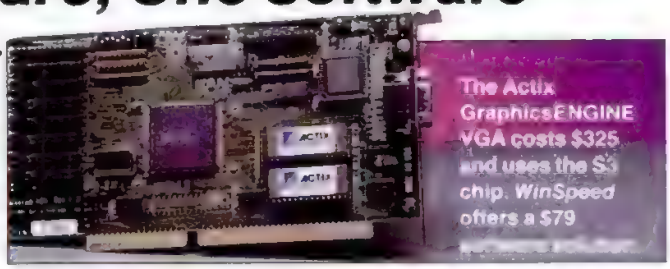
Two Windows Speed Solutions: One Hardware, One Software

Actix Graphics-ENGINE VGA

HANDS ON
By Michael Cohn



The Actix GraphicsENGINE VGA costs $325 and uses the S3 chip. *WinSpeed* offers a $79

A new high-resolution graphics accelerator board, the Actix GraphicsENGINE VGA, can give your Windows applications a big boost in video performance without putting a big dent into your wallet. Based on S3 Inc.'s 86C911 chip, the GraphicsENGINE accelerates Windows performance over standard "dumb frame buffer"-based VGA boards at the affordable price of $325 for its 512K version. Actix's version with 1MB of video RAM costs just $379, which is just as reasonably priced.

The GraphicsENGINE VGA gains its speed by running common GUI operations like image and bit-block transfers (BitBlts), fills, and line draws in the S3 chip, rather than stealing clock ticks from the system by off-loading the instructions onto the CPU and risking bottlenecks on the I/O bus. Both the 1MB and 512K versions of the GraphicsENGINE come with Windows drivers supporting 640-by-480 resolution at 16 and 256 colors, and 800-by-600 and 1,024-by-768 resolutions at 16 colors. The 1MB board also provides 256-color drivers for Windows at 800-by-600 and 1,024-by-768 resolutions, as well as a 16-color 1,280-by-960 driver. Actix also promises 32,768-color support in January in the form of a $20 upgrade option via the Sierra RAMDAC. The GraphicsENGINE VGA drives monitors at refresh rates up to 72-Hz for low-flicker computing. The package also includes dedicated drivers for Windows, *WordPerfect*, *Microsoft Word*, *Lotus 1-2-3*, *Ventura Publisher*, *Generic CAD*, *AutoCAD*, *CADvance*, and *CADkey*.

Installing the Windows drivers is a simple matter of running the Windows Setup program and changing its video display selection. You also need to set DIP switches on the board to match your monitor's maximum resolution and refresh rate. The manual includes a helpful diagram that shows the appropriate switch positions.

For most of PC Magazine Labs Graphics Performance Tests for Windows 3.0, the GraphicsENGINE VGA outperformed the ATI VGA Wonder XL, voted the Editors' Choice in our Super VGA graphics adapter review (see "SVGA Boards: Fast Enough for Windows, Cheap Enough for You," September 24, 1991). The GraphicsENGINE also matched the performance of ATI's newest coprocessed video board, the 8514/A compatible Graphics Vantage. It did not run strongly in our DOS-based VGA performance tests, perhaps because it is optimized for Windows and CAD operations; the ATI boards consistently outperformed it there.

The GraphicsENGINE VGA comes with a one-year warranty and toll-free technical support. Windows users will find this accelerator board a satisfying way to soup up screen-drawing operations and add high-resolution visibility to their systems at a reasonable cost. ■

List Price: Actix GraphicsENGINE VGA (with 1,024K RAM), $379; Actix GraphicsENGINE 512K, $325.
Requires: VGA, Super VGA, or multiscanning monitor; DOS 3.0 or later. Actix Systems Inc., 4633 Old Ironsides Dr., #310, Santa Clara, CA 95054; 800-927-5557, 408-986-1625.

CIRCLE 707 ON READER SERVICE CARD

GRAPHICS PERFORMANCE TESTS FOR WINDOWS 3.0

LABS

Panacea's *WinSpeed* clearly demonstrates that the current generation of Super VGA boards can benefit from software optimization. But for those willing to pay for new hardware, the superior processing power found in the new S3 chip in the Actix GraphicsENGINE VGA can increase video performance as much as tenfold over today's Super VGA boards.

The **Aligned** and **Nonaligned BitBlt** tests draw a 256-by 256-pixel square and use the Microsoft Windows 3.0 function BitBlt (bit-block transfer) to move it from one screen location to another—which is similar to moving a cursor, icon, or window across the screen. Using nonaligned BitBlts requires far more CPU overhead because it is necessary to compute the screen-memory offset position.

The **Draw Horizontal** and **Draw Diagonal Lines** tests use the Windows 3.0 LineTo function to draw lines on-screen. For non-coprocessed boards, diagonal line draws are far more CPU-intensive, since both *x* and *y* coordinates are incremented

The **Random Rectangles** test measures the time it takes the graphics adapter and driver to draw a series of random rectangles, which is a common Windows operation used in drawing title bars and menus

We performed all tests using Windows 3.0 in 386 Enhanced mode on a Compaq Deskpro 386/25e with 8MB RAM, running at 800-by 600-pixel 256-color resolution, with a screen refresh rate of 72 Hz.

Throughput (thousands of pixels per second)
Higher scores represent better performance

	Aligned BitBlt	Non-aligned BitBlt	Draw Horizontal Lines	Draw Diagonal Lines	Random Rectangles
SOFTWARE ACCELERATION					
Orchid ProDesigner IIs	2,021.2	1,036.3	336.2	189.5	2,922.3
ProDesigner IIs with *WinSpeed*	1,978.1	1,959.8	1,808.5	337.3	4,219.7
HARDWARE ACCELERATION					
ATI Graphics Vantage	11,341.0	10,552.6	3,606.0	3,797.4	13,059.8
Actix Graphics ENGINE VGA	10,701.8	10,425.3	4,128.4	4,105.4	6,678.8

WinSpeed

HANDS ON
By Matthew J. Rose

For many people, buying a new graphics board to accelerate Windows performance is much like a visit to the dentist—painful and expensive. If you are among the almost one million users who has purchased a Super VGA card in the last year, but are not satisfied with your system's performance under Windows, Panacea may have a low-cost, easier-to-implement solution for you. The New Hampshire-based computer graphics software shop that sped up *AutoCAD* with its display drivers is currently looking to do the same for Windows with its new software accelerator (really a display driver), the $79 *WinSpeed*.

WinSpeed's installation is a bit unusual. First the software determines which VGA chip your video adapter uses. It then decompresses the appropriate replacement Panacea video drivers for Windows and updates Windows' SETUP.INF

CONTINUES ON PAGE 50

First Looks

Windows Accelerators

CONTINUED FROM PAGE 49

file on its floppy disk. You then select the desired *WinSpeed* driver (they appear among the video driver choices) from the Windows Setup dialog box within Windows 3.0.

Next, you can choose to install all three possible resolutions (640 by 480, 800 by 600, and 1,024 by 768), or conserve disk space by choosing just the driver you need. (If you choose more than one, you can toggle between them during normal operations.)

WinSpeed's install procedure has problems, since it essentially doubles as a simple form of copy protection. There's room to expand only one set of drivers on its floppy. Users who change video boards will be prompted that the program has already been installed. Of course you can get around this by deleting the expanded .DRV driver files from the floppy disk before installing another set of drivers. Still, this might frustrate less sophisticated users and if you change boards often it can be a nuisance.

Once installed, the results are tremendous. As our Graphic Performance Tests for Windows 3.0 on a Tseng Labs–based Orchid ProDesigner II show, *WinSpeed* offers consistently better performance. In some cases the increase is more than five times that of the comparable 256-color Orchid Windows driver. Our testing reveals that more complex graphics operations receive the largest boosts. *WinSpeed* also has greatly optimized Windows' ability to draw horizontal lines by reducing much of the unnecessary overhead performed by most current Windows drivers. This will result in real benefits, since this Windows function is often used by most Windows graphics packages.

Is *WinSpeed* better than a hardware board like the Actix? It may be if you have a Super VGA board with at least 512K of video memory and either an ATI, Paradise, Trident, Tseng Labs, or Video Seven VGA chip. Panacea claims that nearly 85 percent of the Super VGA cards sold fit these requirements, and the company offers a money-back guarantee if your system proves incompatible. On the other hand, *WinSpeed* offers only 256-color support. Those with heavy computer graphics requirements will likely opt for new hardware to speed Windows and increase color support simultaneously.

But for the rest of us, *WinSpeed* offers more speed and colors (it's even faster at 800-by-600 resolution with 256 colors than Windows' own 16-color VGA driver) at a moderate cost. And given the current performance of Windows drivers, the boost *WinSpeed* will give your system is definitely worth a look. Just think how much a new video board would cost instead. ■

List Price: *WinSpeed*, $79. **Requires:** Compatible VGA adapter with 512K video RAM, Windows 3.0. Panacea Inc., 24 Orchard View Dr., Londonderry, NH 03053-3376; 800-729-7420; 603-437-5022.

CIRCLE 708 ON READER SERVICE CARD

Simple Presentations For Under $250

HANDS ON by Alfred Poor

Power Up Software Corp. has built its reputation on a family of products that cost about $100 or less and that solve fairly narrow productivity problems with limited but useful functionality. The company is branching out with more complex products, and the $249.95 *Express Presenter* is the vanguard of these new releases.

Express Presenter is a DOS-based presentation graphics program that relies on its own graphical user interface. Power Up has used Business & Professional Software's *35mm Express* (see "Presentation Graphics," May 14, 1991) as a foundation, adding functionality and improving ease of use.

Express Presenter's pull-down menus offer access to a wide range of features including a spell-checker, overlays, and stylesheets.

For example, you can spell-check your presentation, look at thumbnail sketches of your slides, and produce speaker's notes. *Express Presenter* supports a wide range of output devices, from laser printers to film recorders and slide bureaus.

Essentially menu driven, it has options available depending on the view you're using. Each image has a data screen where you enter text or values, a graphics screen where you can view and adjust settings such as colors and alignment, and an annotation screen where you add additional text or clip art. The package comes with clip-art images, and you can import CGM files as well.

Express Presenter offers a gallery of standard chart formats. You can put two or four charts in a single slide, but you have to create each one separately and place them in different sections of the screen. These separate images are then used as overlays to create a single slide.

There are many special effects such as graduated backgrounds and start and end colors that you can apply quickly and easily. It can automatically create drop shadows for text, including graduated shading for the drop shadows. And you can select the shades you want for the top and sides of 3-D bars. The program's MasterCharts and predefined styles make it easy to create sets of slides with a common visual appearance.

Express Presenter is fairly easy to use as long as you stick to the preset designs. The menu structures are not always logical, and it can take both time and keystrokes to make a simple change. For instance, to turn off the numbers that print the values on some bar charts, you have to set the text to "no" color so the numbers disappear.

The slide show features are also limited. You can create only a linear sequence of slides with no transition effects.

The $250 price tag is a little high for this program, given the rapid price erosion for top-end packages. However, if you only need to put together presentations several times a year, *Express Presenter* can help you create attractive slides quickly without spending a lot of time and effort relearning the program each time. ■

List Price: *Express Presenter*, $249.95. **Requires:** 640K RAM, DOS 3.0 or later, CGA or better display adapter. Power Up Software Corp., 2929 Campus Dr., San Matteo, CA 94403; 800-851-2917, 415-345-5900.

CIRCLE 447 ON READER SERVICE CARD

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Relational Applications and Customized User Interfaces without Programming.	YES	NO*	NO	NO
Fully relational	YES	YES	YES	NO
Automatic data integrity and validation at the database level.	YES	NO	YES	YES
Directly .dbf file compatable.	YES	YES	NO	NO
Full network support without programming.	YES	NO*	NO	YES

*Some programming required. **Data verified by technical support representatives at the respective companies.

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CIRCLE 233 ON READER SERVICE CARD

File Wizard Unclutters LAN Disk Space, Saves Hours of Detective Work

HANDS ON
by Steve Rigney

What a relief it would be to have an assistant whose sole responsibility would be to keep tabs on the use of network disk space, to sort through all unused, outdated, or duplicated files, and to save you the untold hours it now takes to search manually through directory lists or trees! Enter Knowzall Systems' *File Wizard*, a file analysis and management utility that does precisely those things. The program is priced at $395 for a single-server license, $595 for three servers, and $995 for eight servers.

The product works on Novell's *NetWare 2.x* (excluding ELS Level I) and 3.*x* networks to track the status and utilization of the server's hard disk and provide network administrators with information they can act on. In other words, *File Wizard* is a utility every *NetWare* administrator should have on his or her desk.

File Wizard scans up to 99 volumes, holding up to 4GB per volume, and handles as many as 1,000 active users per volume, 2,500 files per directory, and 32,000 unique filenames per volume. Installation is easy, though it should be mentioned that the manual could be more thorough.

Once you become familiar with the program, *File Wizard* becomes an excellent tool for analyzing and controlling *NetWare* server hard disks, generating reports, and making projections, all through colorful graphical charts that depict the contents of drives. The program can also be directed to take actions based on those projections.

You can set up *File Wizard*'s graphical chart format to specify different criteria: ownership, last access, last update of the file, file extensions, directories, scan attributes, date filters, and time parameters for each *NetWare* volume. You can also choose a file selection criterion during setup that divides the age of files into 13 time-interval categories.

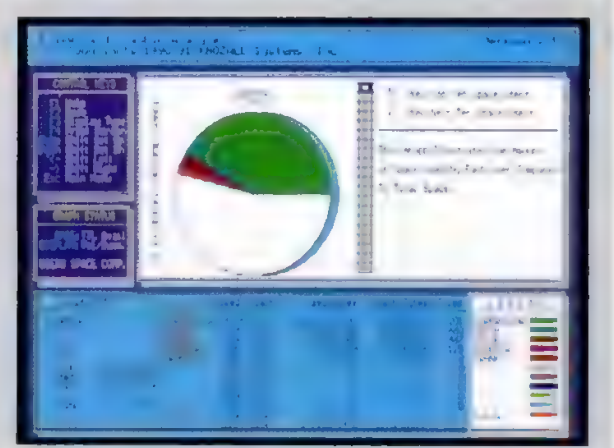
From the program's main menu, you can launch *File Wizzard* into either a Quick Scan or a Complete Scan to gather the information you specified. In our tests, it took approximately 2 minutes to perform a Quick Scan at 250MB volume—quite speedy. An image of a stick figure runs across the screen as *File Wizard* is working. When the scan is completed, you can view the gathered data by going to the Graphic Analysis menu and displaying a colorful graphical chart representing disk usage.

File Wizard displays reports in several flexible formats that allow you to use free space, total space, file extensions, users, and dates as comparison criteria. In particular, the program's ability to automatically search for and identify specific categories of files saves hours of manual detective work you would otherwise spend searching directory lists or trees trying to find old, unused, or duplicated files and deciding what to do with them.

While *File Wizard* can't remedy some of the problems it diagnoses, one unique feature the program possesses is its ability to take the history of disk usage and project future disk-space requirements. Armed with this invaluable information, an administrator can take precautions to slow the inevitable sprint toward a "disk full" status, or make arrangements to augment or upgrade the current file-server disk.

Unlike most disk diagnostic utilities that simply show and tell, *File Wizard* goes beyond supplying a printout to help you act on the information it has gathered. Using the Log Maintenance menu, you can edit and view an Action Log that lists the files and identifies duplicate files, or lists any files meeting your specified criteria. You can delete or archive duplicate files or those created before a certain date. When the program archives files, it remembers their original location and can restore them to that directory when needed.

After scanning the disk and deciding on the appropriate actions to take, you can simply delete or archive the *File Wizard* information, or you can use *File Wizard*'s utilities to send network file information to the appropriate user.



File Wizard tracks the status and utilization of the server's hard disk and offers detailed information in highly graphical formats.

FACT FILE

***File Wizard*, Version 2.0**
Knozall Systems, 375 E. Elliot Rd., #10, Chandler, AZ 85225-1130; 800-333-8698, 602-545-0006
List Price: Single server, $395; three servers, $595; eight servers, $995
Requires: 512K RAM; DOS 3.*x* or later; *NetWare* ELS II, 2.*x*, or 3.*x*.
In Short: *File Wizard* 2.0 is a file analysis and management utility for Novell's *NetWare* that lets network administrators keep detailed tabs on the use of disk space and delete or archive unwanted files.

CIRCLE 702 ON READER SERVICE CARD

Network users are notified about the recommended file action through one of two utilities. FWCHKLOG.EXE displays the activity log with the various files and recommended courses of action. This executable file should be loaded in users' log-on scripts to notify them of questionable files and actions for these files when they log on. The user then has the choice of accepting or changing the recommended action and sending it back to the supervisor.

This communication between user and supervisor is an exciting feature that ensures prompt redress of the problem of misuse of space on the LAN. The second, more powerful utility, FWLOG.EXE, offers the same features as FWCHKLOG.EXE, and it gives you the option of checking the archive log and viewing or retrieving archived files.

Knozall Systems' *File Wizard* is not just another an arcane diagnostic utility that you'll use only occasionally. It's a tool you'll use daily to eliminate the number-one plague of LAN disk space—old or duplicated files. While the scan feature is useful by itself, the ability to scan selectively, recommend actions, and notify individual users who in turn can respond back makes *File Wizard* an important utility that no serious *NetWare* administrator should be without. ■

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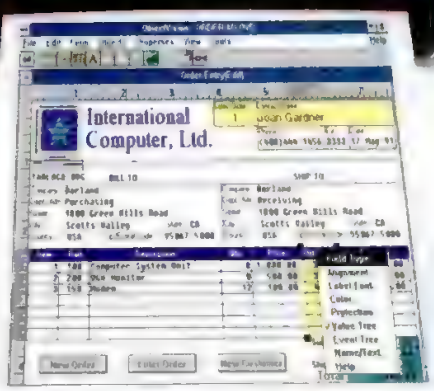

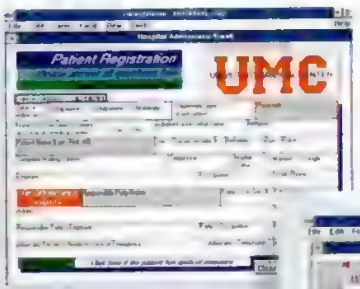

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CIRCLE 287 ON READER SERVICE CARD

NISCAN Spectra: A Healthy Compromise Between Flatbed and Hand Scanning

The 24-bit color NISCAN Spectra doesn't take up much space and performs accurate scans.

HANDS ON
by Daniel Rubenstein

Until now, getting an affordable scanner meant settling for hand-held scanners, which lack accuracy and 24-bit color. Serious color scanning typically requires large, expensive, real-estate-consuming devices. NISCA provides 24-bit color in a small footprint with the $995 NISCAN Spectra scanner.

This lightweight desktop scanner measures 11 by 6 inches, but scans images in a 4- by 6-inch area—about equal to what you'd scan with a hand-held unit. Because it's stationary, the scans are accurate.

The unit scans in black and white, 16 or 256 gray scales, 256 colors, and 16.8 million colors. Since it uses a serial port, there's no fiddling with interface cards. While most color scanners rely on color light sources or multiple filters, the Spectra features a metal-on-silicon sensor for one-pass scanning and a color corrected white light for accurate color. The result is a close match with input and output images.

Place it on top of art or photos and issue the scan command from either *ColorLab* for Windows or *ScanRIX* for DOS. The Spectra will even scan transparencies when placed on a light table, or objects when suspended above them.

Hardware gamma correction (adjusting the color range to match input and output) and brightness is controlled within the software. *ColorLab* makes it easy to set up the scanner and adjust resolution, zoom, output device, and mode (color, gray scale, or black and white). It also offers a prescan so you can preview your image quickly. Once you scan your image, you can adjust color, balance, brightness and contrast, and gamma values.

Other *ColorLab* features include merge for two images, rotation, smoothing and sharpening, and filters for dithering. *ScanRIX* does not include prescan or merge, but its companion tool, *ColorRIX*, provides paint and editing tools. *ColorLab* supports TIFF, .CPI, .BMP, .GIF, EPS, .PCX, Targa 16, Targa 24 and Targa M-8 file formats. *ScanRIX* supports .PCX, Targa 16, Targa 24, and .VMG file formats.

A scan at 150-dot-per-inch resolution (the unit scans from 50 to 400 dpi) took 11 minutes. The slow scan can be attributed to the speed of the serial port. Using the Everex Viewpoint TC 24-bit video card and *ColorLab*, we found that our merge of two scans of the same image produced inconsistent tonal ranges. NISCA says that new software should be available in early 1992. Still, the NISCAN Spectra offers affordable, reliable 24-bit scanning. ■

List Price: NISCAN Spectra for the PC, $995. **Requires:** 640K RAM, hard disk, VGA graphics display. *ColorLab* requires Windows 3.0 with 2MB RAM. NISCA Inc., 1919 Old Denton Rd., #104, Carrollton, TX 75006; 800-245-7226, 214-242-9696.

CIRCLE 449 ON READER SERVICE CARD

SideBar and WinEZ: No-Fuss File Launchers for Windows

HANDS ON
by Barry Simon

Why mouse-click through Windows' directory trees to switch directories when it's easier to just type in "cd \words\doc"? Two Windows launchers offer simple, elegant alternatives to Windows tree navigation: Paper Software's $100 *SideBar* and New Generation Software's $30 shareware program, *WinEZ*.

SideBar is a strip of icons that acts as a combined program/file/task manager for Windows. You position the long, narrow icon sidebar along the side of the screen. Its buttons at the top let you cascade or tile all open windows, or maximize the current window. *SideBar*'s own windows list separate directories and task lists of filenames or icons.

A command line lets you type "dir *.cgm" instead of fooling with a file-entry dialog box. A launch menu also pops up when you hit your right mouse button on a blank area of the desktop. Normally, the menu reads your Program Manager groups, but you can configure it further by adding items not in the Program Manager groups, or by deleting items.

You can perform file operations by dragging filenames from one window to the other, or by entering move, delete, copy, or rename commands.

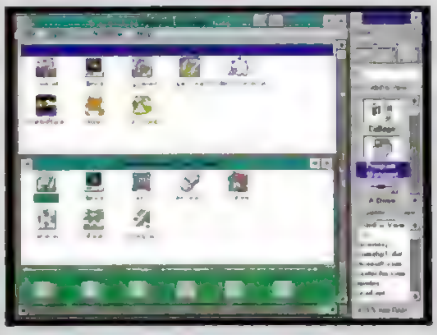
One bothersome feature is the program's tendency to reveal applications like screen blankers that you want to remain hidden; it would be better if they didn't appear either as an icon or a task. Though the command line could be improved with a recall feature and with aliases that would let you assign a short name to a longer command. *SideBar* has a spare elegance and purity that will appeal to many Windows users.

Another model of polished simplicity is New Generation Software's $30 shareware gem, *WinEZ*. This program places two buttons on the side of the active window's title bar. The left displays a launch menu built from Program Manager groups, the right a task list with an enhanced run command. ■

List Price: *SideBar*, Version 1.0, $99.99. **Requires:** Windows 3.0. Paper Software Inc., P.O. Box 567, New Paltz, NY 12561; 914-255-0056.

List Price: *WinEZ*, Version 2.1, $29.95, shareware; download for trial use from PC Magnet's Utilities Forum, LIB 10, WINEZ.ZIP. **Requires:** Windows 3.0. New Generation Software, P.O. Box 890482, Houston, TX 77289; 800-964-7638, 713-283-6760.

CIRCLE 701 ON READER SERVICE CARD


On the right of this Windows display, *SideBar* shows an icon task list and text directory. *WinEZ*'s launch and task list buttons are on the Program Manager's title bar.

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CIRCLE 285 ON READER SERVICE CARD

Two Traveling Mice: One Software, One Hardware

NoMouse

HANDS ON
by Barry Simon

Laptop users who try to take Windows on the road invariably stumble on the portable mouse issue. You can't use a normal-sized mouse on an airline tray, so "upside down" mice like Microsoft's BallPoint and others like the MicroSpeed MicroTRAC (reviewed on this page), have become popular. But these devices are often awkward. They require some odd form of manual dexterity and can be tiring on the fingers. Abacus Software's $50 *NoMouse* offers a software-only mouse alternative for Windows users.

You'll want to install *NoMouse* to load automatically with Windows so that you have immediate mouse access. Once you have installed *NoMouse*, one set of cursor keys moves the mouse cursor, and the Ins and Del keys act like the buttons on your mouse. You can even click and drag holding the Ins or Del key and moving the cursor keys simultaneously.

A hotkey toggles between normal keyboard mode and the mode in which some keys emulate a dynamic motion mouse, which means *NoMouse* accelerates as you move. You can also adjust the initial speed and acceleration rate.

With one glaring exception, the program is well thought out and filled with options. With the Home, End, PgUp, and PgDn keys, you can move the mouse diagonally; with the mouse arrows plus a Shift key, you can move the cursor a pixel at a time. To move the mouse cursor to screen edges, you can configure the Ctrl-Arrow key combinations. Using the *NoMouse* is a more cerebral activity than guiding a real mouse. For example, to open a Program Group window, you use the cursor keys to move the pointer to an icon and press the Ins Key. Then launch a program by hitting Ins twice. To resize a window, move the pointer to the lower right corner of a window and hold Ins and a cursor key together.

The mouse cursor can grow to twice its usual size, a feature sure to be appreciated by laptop users, and a point on the screen can be set as a mouse "anchor" and returned to with a hotkey. You can also change the hotkeys and the keys that emulate mouse buttons, but the choice of which keys emulate mouse movement is limited to the keypad or the extra cursor keys on an Enhanced keyboard.

NoMouse has one serious flaw. On a full 101-key keyboard that has two sets of cursor keys, you can have normal cursor motion and mouse emulation at the same time. But on a typical laptop, which has only one set of cursor keys, you have to toggle with a hotkey between mouse emulation and the normal cursor action—quite an inconvenience. It's unfortunate that some alternate set of cursor keys isn't available.

Using *NoMouse*'s mouse emulation isn't nearly as natural as a real mouse, but I found it no more awkward than a trackball. Laptop users who want to run Windows should seriously consider *NoMouse* as an alternative to laptop pseudomice. ■

List Price: *NoMouse*, $49.95. **Requires:** Windows 3.0. Abacus Software, 5370 52nd St. SE, Grand Rapids, MI 49512; 800-451-4319, 616-698-0330.

CIRCLE 450 ON READER SERVICE CARD

MicroTRAC Trackball

HANDS ON
by Carol Ellison

MicroSpeed's MicroTRAC Trackball for laptops is an interesting newcomer in the quirky universe of portable pointing devices. With its wide buttons, coiled cord, and thumb-sized trackball, it differentiates itself from existing portable devices. But like many of these eccentric gadgets designed to bring pointing to laptop screens, this $89.95 device suffers from ergonomic flaws—flaws that aren't so unusual for devices that are smaller than apricots.

Measuring only 0.6 by 2 by 2.8 inches (HWD), the MicroTRAC's size is both its chief advantage and its primary detraction. It fits neatly in the palm of your hand and is designed to clip onto the side of a laptop with a metal bracket and Velcro-like adhesive pads—ideal for working in small spaces such as tray tops in airplanes. It can also be rested in a stationary position on any work surface. A carrying case is included.

At its center is a tiny trackball (three-quarters of an inch in diameter) with three wide buttons that fan out toward the edge and offer plenty of surface area for a thumb or finger to manipulate the pointer on-screen. The buttons are large. The top button is used to place the pointer when repositioning it on-screen. At the right is the drag button that you click to initiate a drag or highlight; you click again to deactivate it. The left button is the secondary button, equivalent to the right-hand button on a Microsoft mouse.

The unit also features a tiny red LED that lights up when any of the buttons are pressed. When the right-hand drag button is pressed, the LED remains lit until the drag button is depressed again.

Most right-handers should find the default button assignments comfortable, but you can easily reprogram them by holding down the right and left buttons and using the center button to click through the three different sets of possibilities.

Installing MicroTRAC's software is as easy as loading the bundled *Precision Pointer* drivers from the accompanying disk. The *Presision Pointer* driver adjusts the trackball resolution and speed of the unit. It also works with any Microsoft-compatible mouse drivers. You don't need to install MicroSpeed's own software if you already have a mouse installed. Simply unplug your mouse and plug in MicroTRAC.

MicroSpeed solves the problem of long entangling cords by using a telephone cord–style coil that's just over a foot long before stretched. Once stretched, though, the cord on our test unit was reluctant to coil back to its abbreviated length.

Like any pointing device that uses an economy of plastic to insure light weight and portability, it takes a toll on your hands after long periods of use. After about 90 minutes, my finger joints remembered what it is to experience writer's cramp.

MicroTRAC may be your best bet for filling up the lost hours spent on planes and trains, but if you intend to make heavy use of your portable while on business trips, you'll still want to pack a full-grown mouse in your suitcase. ■

List Price: MicroTRAC Trackball, $89.95. **Requires:** . 16K RAM, DOS 2.0 or later, 9- or 25-pin serial port or PS/2-style mouse port. MicroSpeed Inc., 44000 Old Warm Springs Blvd., Fremont, CA 94538; 800-232-7888, 510-490-1403.

CIRCLE 448 ON READER SERVICE CARD

The small-footprint MicroTRAC trackball clips onto a laptop, rests on any work surface or in the palm of your hand. It's got larger buttons, but is smaller overall, than

PHOTOGRAPHY: THOM O'CONNOR

Ambulance Car Virus. Ambulance randomly moves across bottom of display.

Friday 13th Virus. Alias "Black Friday." Erases programs when you try to run them.

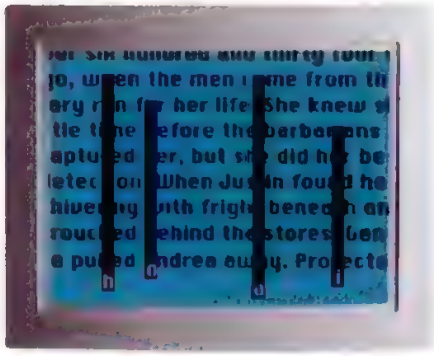
Disk Killer Virus. Alias "Ogre." Causes unexpected formatting of your hard disk.

Stoned Virus. Alias "Hawaii." Data loss caused by damage to directory and FAT.

Datacrime Virus. Adds garbage to files and reformats disk.

AirCop Virus. Alias "Red State." Attacks boot sector on non-write-protected diskettes.

Ping Pong Virus. Alias "Bouncing Ball." Wipes characters off the screen.



Falling Letters Virus. Characters fall to the bottom of the monitor. Creative, but a real nuisance.

With over 50 new viruses each month, who knows what's next.

You Could Get By Without An Anti-Virus Program. Then Again, So Could These.

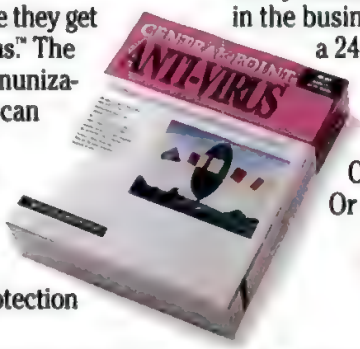
These days, with networks, modems, laptops, and more and more people sharing files, it's only a matter of time before a virus attacks your data.

PC MAGAZINE EDITOR'S CHOICE Oct. 1991

To make sure you get them before they get you, you need Central Point Anti-Virus.™ The only anti-virus program with File Immunization that protects your files so they can never be infected again. Central Point Anti-Virus detects over 800 viruses and destroys twice as many viruses as other programs. It'll even protect you from unknown viruses by searching for suspicious behavior.

It's also the best anti-virus program for protection inside Windows, and it works great across your Novell network.

And since there are about 50 new viruses popping up every month, we give you the most comprehensive support in the business. Including a free update, quarterly mailings, a 24-hour hotline with FaxBack, and BBS and CompuServe support forums.



If you want the most complete virus protection, there are really only two things you can do. Call **1-800-445-4076** for more information. Or unplug your computer.

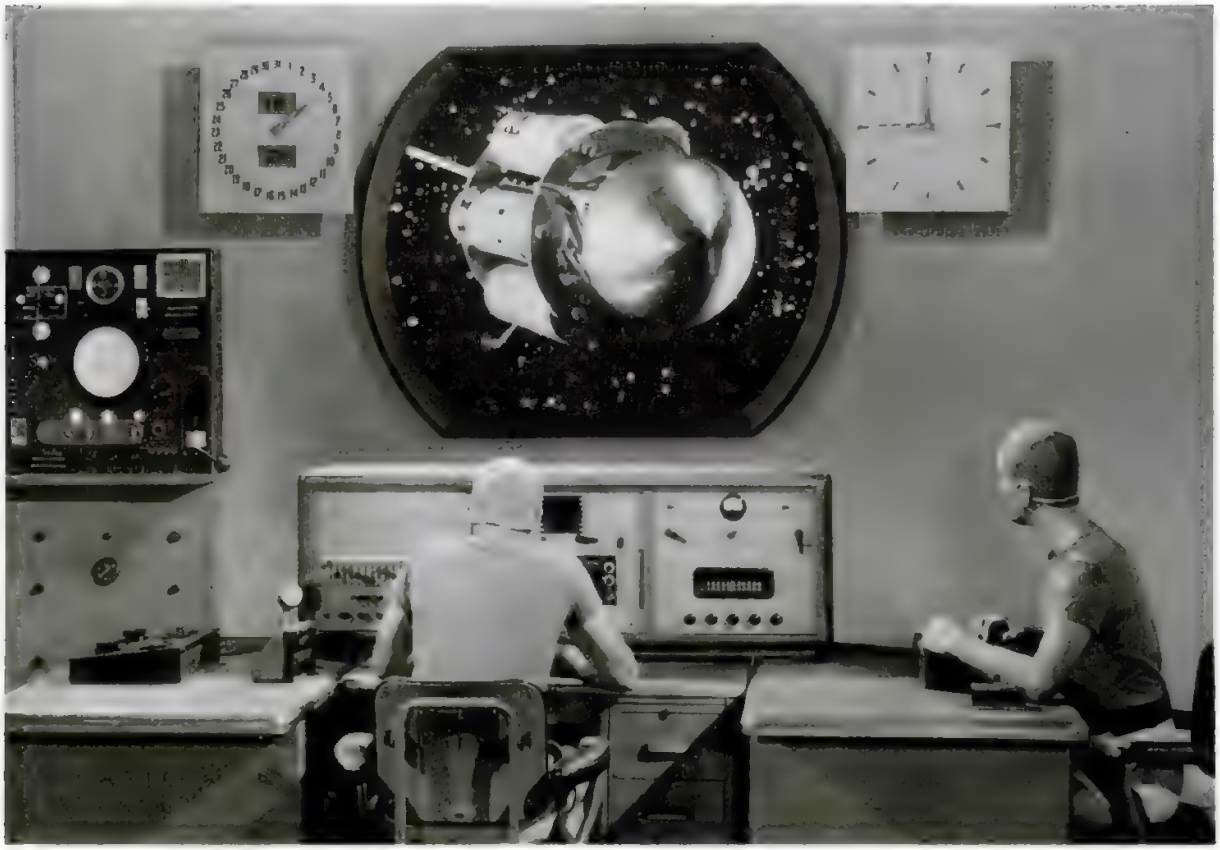
Central Point Software INC®

Making Computing Safer, Simpler, Faster.

Central Point Anti-Virus is a trademark of Central Point Software Inc. Names of other products mentioned herein are used for identification purposes only and may be trademarks and/or registered trademarks of their respective companies

CIRCLE 749 ON READER SERVICE CARD

SAMSUNG HAS A MONITOR FOR VIRTUALLY EVERY NEED.



Name/Model	Type	Size	Resolution	Category
MA2565	Amber Mono.	12"	720x350	MDA
MZ4571	Flat Screen Mono	14"	720x350	MDA
ML2611	White VGA	12"	640x480	VGA
ML4571	Flat Screen White	14"	640x480	VGA
CVL 4951/5/6	VGA Color	14"	640x480	VGA
SyncMaster™ 2e/3e	EVGA Color	14"	1024x768	EVGA
PageMaster™	Full Page White	15"	1006x1048	DTP
SyncMaster™ 4	Flat Screen Color	17"	1024x768	MULTI
PageMaster™ 2	2-Page White	20"	1280x1024	DTP
DesignMaster™	High Res. Color	20"	1280x1024	CAD

Monitors for business, industry and the home. Monitors that support all popular video standards. In monochrome and color.

Monitors for everything. From graphics to CAD/CAM, desktop publishing to multimedia. From 12 inches to 20, from CGA to Super VGA and beyond. Samsung makes them all.

Yet our value as a single source means more than solving customer's needs. It means solving your needs too.

With a lot less paperwork. Reduced training costs. Fewer service agreements. Lower inventory carrying costs. And a manageable number of contacts to work with. All of which adds up to one very important benefit to you. Higher profits.

To take advantage of Samsung as your single source, call 1-800-624-8999, ext. 85BA. We're the world's largest manufacturer of monitors.

Ensuring the easiest, most cost effective way of providing exactly what you, and businesses everywhere, need.

Unless, of course, you happen to be from another planet.

SAMSUNG Electronics

Technology that works for life.

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CIRCLE 316 ON READER SERVICE CARD

by Emerson Andrew Torgan

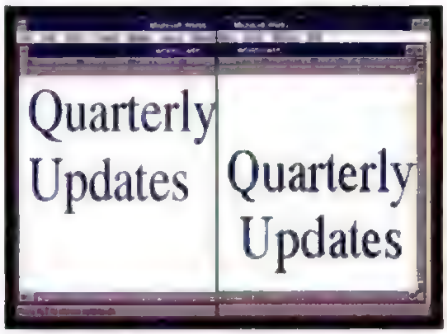
New & Improved

News of Announced Products and Upgrades

Adobe Type Manager 2.0 Speeds Font Rendering

IMPROVED **Adobe Systems** is now shipping *Adobe Type Manager for Windows*, Version 2.0. The new version of the program offers twice the font-rendering speed of Version 1.0 when running on 386- or 486-based machines, according to the company. Users running 286-based machines will not notice any speed gains, but will have enhanced printer support and easier font installation.

The $99 package offers automatic downloading of new fonts for PostScript printers. When used with the HP LaserJet III, *Adobe Type Manager* will defer to printer-resident fonts with the same name, eliminating the download sequence. *Adobe Type Manager* 2.0 includes Adobe Type 1 outline fonts in Times, Helvetica, Courier, and ITC Symbol typefaces, and will support Windows 3.1. Adobe is offering its customers any *Adobe Type Library* package for $39.



***ATM*, which lets you render nonjagged fonts on-screen, is now faster and is Windows 3.1 compatible.**

List Price: *Adobe Type Manager for Windows*, Version 2.0, $99; upgrade for registered users, $20 plus $7.50 for shipping and handling. **Requires:** 1MB RAM, Windows 3.0 or later. Adobe Systems Inc., 1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039-7900; 800-833-6687, 415-961-4400.

CIRCLE 431 ON READER SERVICE CARD

InstaPlan EMS Combines Multiple Projects

IMPROVED **Micro Planning International** is now offering multiple-project capabilities and a preview feature as part of the upgrade to *InstaPlan EMS*, Version 4.0. According to the company, the project-management program can combine and extract multiple projects or subprojects with its append/extract feature. Extracted subprojects can be saved as templates and added to future projects. *InstaPlan EMS* supports as many as 16,000 activities per project, according to the company. A print-preview feature minimizes printing errors by showing page breaks on screen. **List Price:** *InstaPlan EMS*, Version 4.0, $549; upgrade from Version 3.0, $50. **Requires:** 640K RAM, DOS 3.0 or later. Micro Planning International Inc., 655 Redwood Hwy., #311, Mill Valley, CA 94941; 800-852-7526, 415-389-1414.

CIRCLE 432 ON READER SERVICE CARD

HOT PROSPECT

PHOTOFINISH: 24-BIT IMAGE EDITING FOR $199

ZSoft Corp.'s *PhotoFinish*, a Windows-based image-editing package, provides 24-bit painting and retouching capabilities for scanned images. Supporting a wide variety of flatbed and hand-held scanners as well as video-capture boards, *PhotoFinish* controls the scan, image conversion and image-editing features. Conversions between black and white, 256 color, 256 gray scale, and 24- and 16-bit color are all possible. Images containing up to 16.7 million colors and 256 shades of gray can be edited in all video modes.

Automatic retouching filters can be applied to an entire image or a masked area, and can adjust brightness and contrast, remove spots, and sharpen and blend. Traditional tools include a paintbrush, fountain pen, paint roller, eraser, color replacer, eyedropper, and spray can. Tools that create text, lines, and curves also are included. Other tools provide special effects such as blending, smearing, tinting, cloning, and mosaics.

Images can be displayed in multiple windows for comparison when retouching or cutting and pasting, and the menu bar and icons can be hidden. Large scans can be automatically stitched. Designed for mainstream applications, some high-end features are not included.

With *PhotoFinish*, $199 buys you some serious tools for scanning, image editing, and retouching.

List Price: *PhotoFinish*, $199. **Requires:** Windows 3.0, EGA or better, mouse or other pointing device. ZSoft Corp., 450 Franklin Rd., #100, Marietta, GA 30067; 404-428-0008.

CIRCLE 430 ON READER SERVICE CARD

ShowCase VISTA: AS/400 to Windows

NEW **Rochester Software Connection** is now shipping *ShowCase VISTA*, a Windows-based query package for the AS/400. It uses dynamic data exchange (DDE) to connect data obtained from the AS/400 (using its relational database management system) to any Windows application supporting DDE. A built-in data viewer is included.

ShowCase VISTA is the query facility of the package, and it includes *WindowLink*, the actual connectivity component of the package. *WindowLink* was formally marketed under the name *ShowCase Platform*.

Developers can use *WindowLink* directly with any Windows development tool, including Visual Basic, to create custom applications that access data stored on an AS/400. **List Price:** *ShowCase VISTA*, $995 for first copy, $895 for 2 to 50 copies. *ShowCase WindowLink*, $495. **Requires:** Any model AS/400, OS/400 3.0, PC Support 3.0, 2MB RAM, Windows 3.0. Rochester Software Connection Inc., 4909 Hwy. 52 North, Rochester, MN 55901; 800-829-3555, 507-288-5922.

CIRCLE 433 ON READER SERVICE CARD

BRIEFS

DESKTOP PCs

CompuAdd is shipping all 386SXs, 386DXs, and its 486-based CompuAdd 425 ($2,995) in a low-profile stretch chassis to accommodate upgraded 200-watt power supplies. The Model 325 ($1,795) and the Model 333 ($2,295) now include CompuAdd's Hi-Rez video controller with 512K memory on the local bus, and additional cache memory. 800-456-3116, 800-627-1967.

Everex Systems is shipping its line of Tempo C Series PCs in a low-profile 3.5- by 15.5- by 15.6-inch (HWD) chassis, including high-color VGA built onto the system board. Using the same design of the Everex Viewpoint Premium graphics adapter, C Series units offer resolutions of 1,280 by 1,024 with 16 colors and 640 by 480 with 32,768 colors. Both the Tempo 386/25 ($1,899) and the Tempo 386/33 ($2,699) can be upgraded to a 486 processor through a direct CPU replacement plug-in module. 800-628-3837.

NEC Technologies has released the 486 PowerMate Express series of modular PCs, allowing upgrading of the processor, memory, graphics, and disk subsystems with snap-in upgrade modules. All units have EISA slots, 16 SIMM sockets, and NEC's FLASH ROM, allowing BIOS updates via floppy disk. The base model, the PowerMate 486SX/20, is $3,699 with a 120MB hard disk. 508-264-8000.

V-Three Systems is shipping the PowerGate 386/40 ($2,395). Based on AMD's 386 processor running at 40 MHz, the system is configured with 4MB RAM; a 64K SRAM cache; 80387 and Weitek math coprocessor sockets; 16-bit VGA with 512K video memory; a Super VGA 14-inch monitor; two 8-bit and six 16-bit expansion slots; two parallel ports and one serial port; a 104MB hard disk; and a 5.25-inch floppy disk drive. 800-424-3383.

Zenith Data Systems is shipping the Z-486sx/25E Model 200 ($6,199), combining a 486 processor running at 25 MHz and a Model Z-649 Texas Instruments Graphics Architecture (TIGA) video card with 60-MHz processor. Delivering 1,024-by-768

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UMAX Unveils Standalone OCR Machine

NEW **UMAX Technologies** is shipping an integrated standalone optical character recognition machine. The $5,495 **ReadStation** combines a scanner, automatic document feeder, dedicated computer, and Caere Corp.'s *OmniPage* OCR software.

Printed or typewritten documents are fed into the ReadStation, converted to electronic form, and written as files to the built-in 3.5-inch floppy disk drive. Word processing, spreadsheet, and database file formats such as *WordPerfect*, *Lotus 1-2-3*, and *dBASE* are supported, and selectable using a control panel on the front of the unit. The unit can be connected to a PC via an RS-232C or RS-422 serial port interface for direct file transfer.

In text mode, graphics and images are automatically ignored or removed, and settings can be adjusted to read specific areas of a page. In graphics mode, images are saved to a TIFF file format. ReadStation accommodates a maximum document size of 8.5 by 14 inches and has a maximum recognition rate of 115 characters per second.

The ReadStation, an OCR peripheral, can scan your document and then either print it or save it to a built-in floppy disk.

List Price: ReadStation, $5,495. UMAX Technologies Inc., 2352 Walsh Ave., Santa Clara, CA 95051; 800-562-0311, 408-982-0771.

CIRCLE 434 ON READER SERVICE CARD

Designer 3.1 Adds 175 Type 1 Fonts, No Price Increase

IMPROVED With the addition of 175 Type 1 fonts from Adobe Systems Inc. and Digital Typeface Corp., *Micrografx Designer*, Version 3.1, has exceeded the number of fonts currently offered by other PC-based drawing packages. The upgrade also adds *Adobe TypeAlign for Windows*, *Adobe Type Manager for Windows* 2.0 (see New and Improved, page 59), and selected Adobe Original fonts, while maintaining *Designer*'s $695 price tag.

In addition to the 175 Type 1 fonts, *Designer* 3.1 offers 13 Adobe Original typefaces including Lithos, Trajan, and Charlemagne, as well as Adobe Wood Type 2 fonts Birch, Blackoak, Madrone, Poplar, and Willow. According to the company, the addition of *Adobe Type Manager* gives users typeface compatibility with other Windows programs. The fonts in *Designer* can be transported to other Micrografx programs, such as *Windows Draw*.

List Price: *Micrografx Designer*, Version 3.1, $695. **Requires:** Windows 3.0. Micrografx Inc., 1303 Arapaho, Richardson, TX 75081; 800-733-3729, 214-234-1769.

CIRCLE 435 ON READER SERVICE CARD

Software Utility Adds 50 Sounds to Windows

NEW **Aristosoft** has unveiled *Wired for Sound*, a $49 Windows utility that lets users personalize their Windows desktop with over 50 voices, sound effects, and musical cues in a proprietary file format. Sounds can be assigned to application and icon messages, dialog boxes, and to the system startup and exit.

Users can associate text in any dialog box with a specific sound, such as a cracking whip for the startup, a bomb dropping for UAEs, and a flushing toilet when you exit. A talking clock lets you set alarms, and *Wired for Sound*'s dynamic link library is included for use with macros in Windows applications such as *Excel*.

List Price: *Wired for Sound*, $49. **Requires:** Windows 3.0. Aristosoft Inc., 6920 Koll Center Pkwy., #209, Pleasanton, CA 94566; 800-338-2629, 510-426-5355.

CIRCLE 436 ON READER SERVICE CARD

New V.32bis Modems From Intel and Practical Peripherals

NEW **Intel** has unveiled a modem conforming to the V.32bis international standard. The Intel 14.4EX supports data transfer rates of 14,400 bps, delivering 50 percent more performance than 9,600-bps modems. The external, full-duplex unit is compatible with CCITT, V.32 modulation, and V.42 error correction standards. The $699 14.4EX uses CCITT V.42bis data compression to achieve as much as a fourfold compression rate and a maximum throughput of 57,600 bps, according to the company.

The 14.4EX ships with DCA's *Crosstalk Communicator* communications software, which offers 13 different terminal emulations, 8 different file transfer protocols, and installation and diagnostic software.

Practical Peripherals is shipping two

CONTINUES ON PAGE 64

Presenting The Next Page In Printer History. From The Company That Printed The First.

Funny how history has a way of repeating itself. Year after year—actually for the past 25—Epson® has been the leader in dot matrix printing technology.

Introducing six reasons why that leadership is sure to continue: the letter-quality Epson LQ-570, LQ-870, LQ-1070, LQ-1170, ActionPrinter™ 5000 and ActionPrinter 5500.

More Paths To Success.

For sheer paper handling flexibility, no other printer—dot matrix, ink jet or laser—handles quite as well as these.

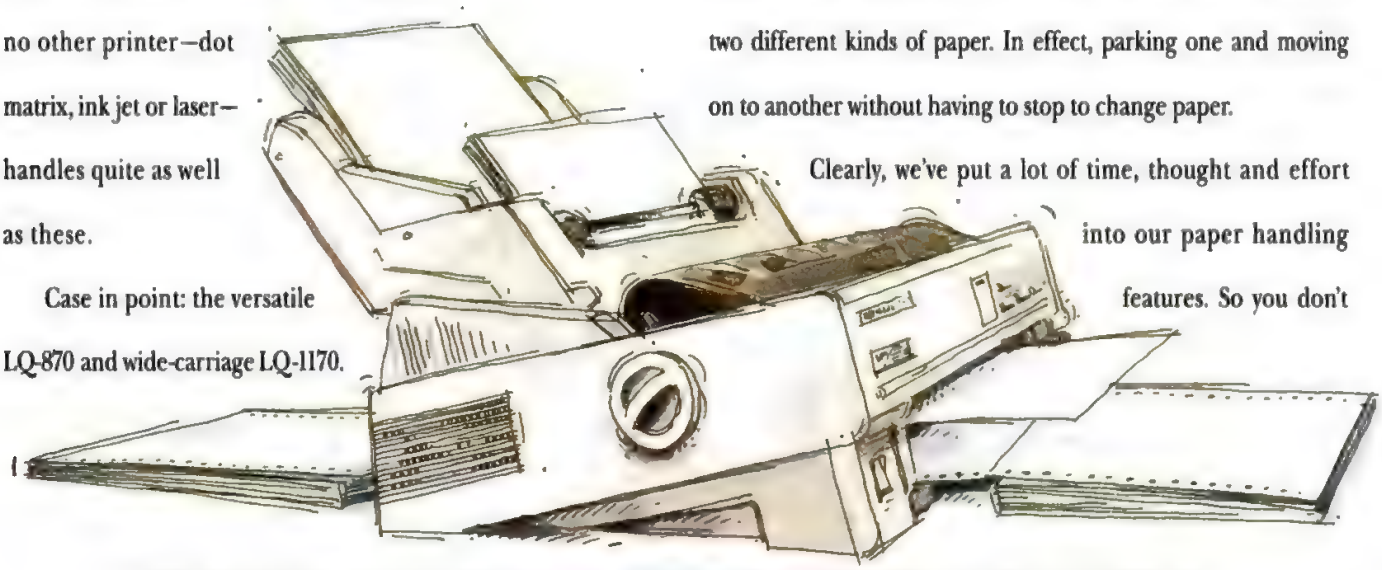
Case in point: the versatile LQ-870 and wide-carriage LQ-1170.

When fully loaded, these printers put as many as five types of paper at your fingertips. Everything from letterhead to continuous-form checks, four-part forms, tractor-feed paper, even envelopes.

All our printers can automatically handle 50 sheets using our optional single-sheet feeder. Add our high-capacity feeder and you're quickly up to 200.

Then there's Epson SmartPark™ paper handling. At the press of a button and flick of a lever, you can easily switch between two different kinds of paper. In effect, parking one and moving on to another without having to stop to change paper.

Clearly, we've put a lot of time, thought and effort into our paper handling features. So you don't



With five different paper paths to draw from at any moment, an Epson LQ printer is as versatile as it is dependable.

All company and/or product names are trademarks and/or registered trademarks of their respective manufacturers. ©1991 Epson America, Inc., 20770 Madrona Ave., Torrance, CA 90509. For dealer referral, call **800-BUY-EPSON** (800-289-3776). In Canada, call (416)881-9955.

have to put much time, thought or effort into using them.

Scale New Heights.

Each new Epson printer comes with a new industry-setting standard—ESC/P2.™ This breakthrough printer control system brings scalable fonts to dot matrix printing.

Simply put, type sizes are no longer as limited. So now you can do things with a 24-pin printer that before could only be done with a laser. And you don't have to give up one bit of paper handling flexibility to do it.

Graphically Superior.

What ESC/P2 does for type, it also does for graphics. Brilliantly.

It includes an enhanced Windows™ driver, exclusive to Epson. When you print from any program running in Windows, you'll get superior output quality and faster throughput speeds.

SCALABLE FONTS

With a new Epson LQ printer, you can print a variety of type in a variety of sizes, up to 32 point.

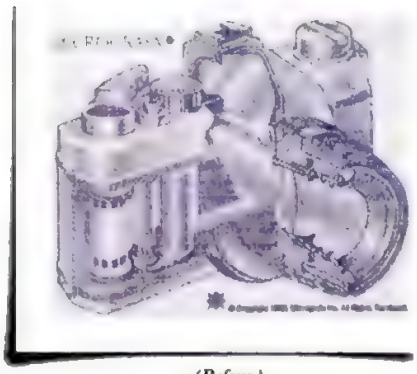
But don't just take our word for it. Take a look at the quality of our graphics instead.

Built For The Long Run.

Epson printers aren't only designed with more firsts, they're designed to last. Each is backed by a generous 2-year limited warranty. As well as a helpful toll-free 800 number to provide you with dependable, expert assistance.

One more thing you can always depend on: Epson reliability. It isn't a claim just any printer company can make. It's a quality—a character trait—our products have earned over time.

To see the latest printer innovations firsthand, visit your nearby Epson dealer, or call 800-289-3776. And see why, after more than 25 years, Epson is still the first name in dot matrix printing.



(Before.)

(Now.)

Epson's enhanced Windows driver improves not only the look of your text and graphics, but the speed at which they print.

EPSON

Desktops

Dot Matrix

Notebooks

Lasers

Servers

BRIEFS

CONTINUED FROM PAGE 60

resolution with 256 colors, the video card's 512K VRAM and DRAM can both be upgraded to 1MB. 800-553-0331.

CAD

The Synthesis Company has released an Automated Design/Drafting package for *AutoCAD*, Release 11. *Synthesis* 3.11 ($995), automates the creation of drawings for *AutoCAD* users. 206-671-0417.

Vertex Design Systems is shipping *CSI Standard CAD Symbols* ($149.50), a software package providing 249 architectural symbols and materials representations (hatch patterns) for use in CAD drawings. The package operates in two modes. The first mode integrates with *AutoCAD*, providing symbol access, scaling, and layering. The second operates under DOS and provides industry-standard .DXF symbols for use with most CAD packages. 415-957-2699.

Fujitsu has unveiled a large-format laser printer that can operate with standard CAD software packages. The VM2200 laser printer ($9,995) is bundled with an HPGL emulation card, the interface for *AutoCAD*, and many CAD programs. The printer delivers 11- by 17-inch output with a maximum resolution of 300 by 300 dots per inch. 800-626-4686.

GRAPHICS SOFTWARE

Jewell Technologies' *The Juggler*, Version 1.0 ($249.95), converts raster and vector images and allows them to work with word processing, desktop publishing, and presentation packages. Image-enhancement features include font annotation and drawing options. Images can be stretched, shrunk, mirrored, rotated, and clipped. 800-284-2574, 206-285-6860.

Computer Support's *Arts & Letters Apprentice* ($169) features over 3,000 clip-art images, a Clip-Art Library Manager, 25 typefaces, and charting and drawing tools for desktop publishing packages. 214-661-8960.

Genus Microprogramming is shipping *GX Text*, Version 2.0 ($149), allowing

CONTINUES ON PAGE 66

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14,400-bps V.32bis data/fax modems. The PM144FX96SA (external version) and the PM144FX96 Half-Card (internal version) are full duplex modems supporting V.32bis, V.32, V.42, V.42bis, MNP levels 2 through 5, and Group 3 send/receive fax capabilities. The units combine 14,400-bps data functions with 9,600-bps send/receive fax modem functions. Both units use V.42 error correction and V.42bis data compression to achieve a maximum throughput of 57,600 bps, according to Practical Peripherals.

List Price: Intel 14.4EX, $699. Practical Peripherals pricing not available at press time. Intel Corp., 3065 Bowers Ave., P.O. Box 58065, Santa Clara, CA 95052-8121; 408-765-8080. Practical Peripherals, 31245 La Baya Dr., Westlake Village, CA 91362; 818-706-0333.

CIRCLE 437 ON READER SERVICE CARD

Computer Speaker System from Bose

NEW **Bose Corp.** is shipping a magnetically shielded speaker system for the PC that will not interfere with video monitors or damage magnetic media. The Bose RoomMate Computer Monitor is designed for computers that take advantage of sound capabilities: MIDI or voice synthesizers, music composition, and Multimedia presentations.

The 9- by 6- by 6-inch (HWD) speakers include proprietary distortion-limiting circuitry, built-in volume control, an amplifier, and active equalization circuitry, according to the company. The RoomMate Computer Monitor ships with adapters and can be connected to all stereo or mono sources.

List Price: Bose RoomMate Computer Monitor, $399 per pair. Bose Corp., The Mountain, Framingham, MA 01701-9168; 508-879-7330.

CIRCLE 438 ON READER SERVICE CARD

CD Gallery Offers Seven Interactive Titles, Reader

NEW **NEC Technologies** is offering a CD-ROM reader bundled with seven interactive CD-ROM software titles. CD Gallery is available with either the Intersect CDR-36 or CDR-73 CD-ROM reader, an interface kit, speakers, and headphones. The CD-ROM readers offered are not MPC compatible.

The PC version ships with *Battle Chess, Great Cities of the World, National Geographic Mammals: A Multimedia Encyclopedia, The New Grolier Electronic Encyclopedia, The Software Toolworks World Atlas, The TIME Magazine Almanac*, and *The Time Table of History: Science and Innovation*.

List Price: CD Gallery with CDR-36 CD-

NEC Technologies creates an affordable bundle with its CD-ROM hardware/software combination.

ROM reader and AT/XT interface, $749; with parallel-to-SCSI interface, $779; with PS/2 interface, $829. CD Gallery with CDR-73 reader and AT/XT interface, $1,050; with parallel-to-SCSI interface, $1,079; with PS/2 interface, $1,129. **Requires:** 640K RAM, 5MB hard disk space, VGA graphics adapter, one open port, DOS 3.3 or later. NEC Technologies Inc., 1255 Michael Dr., Wood Dale, IL 60191; 800-632-4636, 708-860-9500.

CIRCLE 439 ON READER SERVICE CARD

Entry-Level Accounting For Windows

IMPROVED **Platinum Desktop Software,** makers of *Platinum*, is now shipping an entry-level Windows accounting package for small businesses. *Access to Platinum for Windows* (DOS version is currently available) features General Ledger, Accounts Payable, Accounts Receivable, Checkbook, Inventory, Job Costing and Time/Billing, and Payroll modules. Additional features include a mail manager and preformatted reports with each module.

The package includes lookup capabilities and forms orientation, and users can open and work with several forms simultaneously on screen, such as viewing a credit record while entering an invoice.

List Price: *Access to Platinum for Windows*, $249. **Requires:** 3MB RAM, Windows 3.0. Platinum Desktop Software Inc., 15615 Alton Pkwy., #300, Irvine, CA 92718; 800-999-1891.

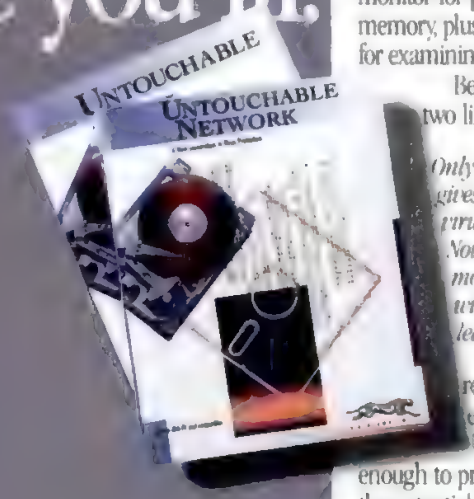
CIRCLE 440 ON READER SERVICE CARD

Print Directly from Any Windows Application

IMPROVED **Custom Applications** is shipping a new version of its Windows-compatible PostScript-language interpreter that lets users print directly and transparently from any Windows application. According to the

CONTINUES ON PAGE 66

Paying again and again for virus protection is enough to make you ill.



Frankly, paying anything at all is pretty nauseating.

But that's nothing compared to the feeling you get in your stomach when a drive full of data goes down the drain.

So you pay.

Then you pay again. For upgrades. Or quarterly "updates."

But even that doesn't buy you much peace of mind. Because each new day brings an average of six new viruses into the world.

Which means all anti-virus programs are inherently obsolete.

Except one.

Introducing Untouchable.™ The only software in the world that gives you 100% protection.

Today.

And tomorrow.

Like other anti-virus software, Untouchable is equipped with a TSR monitor for patroling your system memory, plus a scanner/remover for examining the files on your disk.

Between them, these first two lines of defense can recognize and obliterate hundreds of the little buggers — enough to protect you from 95% of the potential carnage.

Only Untouchable Network gives you centralized virus protection. Now you can install, monitor and control without having to leave your seat.

If you find that statistic reassuring, then you probably like the odds in Russian Roulette.

If you don't, you'll want to know that Untouchable is equipped with a unique *third* line of defense, which has been mathematically proven to be, well, untouchable.

Instead of looking for viruses, this third line of defense looks for *changes in your executable and system files.*

If the change is but a single byte, Untouchable will spot it and, using our patent-pending recovery technique, reconstruct the file to its original state.

The process is known as Generic Differential Detection, and certain other programs claim to perform it, too.

But only Untouchable calculates file signatures using not one, but two proprietary algorithms that can't be reverse-engineered.

Only Untouchable guarantees 100% safe recovery of infected files. (Unlike other programs that proudly generate corrupted files, Untouchable knows when the jig is up and doesn't attempt recovery.)

Only Untouchable can provide centralized network virus protection. In fact, Untouchable Network has enough virus alerts and reporting mechanisms to settle the stomach of even the most nervous Netware® administrator.

And only Untouchable is backed by our vaunted 24-hour toll-free technical support and a one-year money-back guarantee.

If you're worried about viruses — and you should be — don't reach for the Maalox.® Reach for the phone. Dial **1-800-677-1848.**

You'll feel better right away.

FIFTH GENERATION SYSTEMS, INC

CIRCLE 288 ON READER SERVICE CARD

BRIEFS

CONTINUED FROM PAGE 64

display of any bitmapped text in any graphics mode. *GX Text* displays text in most font typestyles using the *GEM* font file-format. A graphical font editor for the creation of custom fonts is included. 713-870-0737.

DATABASE APPLICATIONS

DataEase is now shipping *DataEase Personal* ($99), a relational and programmable single-user database. The package offers a menu-driven interface, and a Query-by-Example reporting facility. Also included are the Names & Addresses and Personal Checkbook & Business Checkwriter applications. 800-243-5123, 203-374-8000.

Information Builders has released *PC/FOCUS*, Version 6.0 ($798), a database development tool with a menu-driven, graphic point-and-shoot interface. The program includes a screen painter to add records to a data-entry screen, and a browser to display and edit existing database records. 212-736-4433.

Donnay Software Designs' *dCLIPjr* ($99.95) contains 700 tutorial screens and is designed to show how to execute commands in *Clipper*, Version 5.01. The tutorials range from elementary operations such as Data Types and Commands to more advanced features like Code Blocks and Multi-Dimensional Arrays. 714-263-1011.

Baler Software's *bBASE* ($199) allows spreadsheet applications to read and write data stored in *dBASE* (.DBF) files, and lets users browse, edit, and specify search criteria in each database. Users may also update values of specified fields for all selected records using the Data Release function. 800-327-6108, 708-506-9700.

Videotex is now shipping *T-BASE*, Version 3.0 ($495). The package lets users add pictures and document images to database management applications written in C, C++, and most Xbase dialects. *T-BASE* supports the .PCX file format and is shipped bundled with *ChromaTools*, a color manipulation and image conversion utility. 800-888-4336.

CONTINUED FROM PAGE 64

company, *Freedom of Press*, Version 3.0, allows output of PostScript-language files to more than 50 non-PostScript color and monochrome output devices including ink jet, dot matrix, laser, and color thermal transfer printers, as well as 24-bit film recorders.

The package includes 35 scalable and routable outline fonts and supports *Adobe Type Manager* and Adobe Type 1 fonts. Additional features include a print preview, file log, and .PCX file format output for high-resolution fax cards. Custom Applications strongly suggests running *Freedom of Press* with a math coprocessor for improved graphics performance.

List Price: *Freedom of Press*, Version 3.0, $495. **Requires:** 640K RAM, 1MB XMS, 7MB hard disk space, Windows 3.0, Windows PostScript driver. Custom Applications Inc., 900 Technology Park Dr., Building 8, Billerica, MA 01821; 800-873-4367, 508-667-8585.

CIRCLE 441 ON READER SERVICE CARD

"Universal" Font Conversion for Windows

NEW **Atech Software** has released *AllType*, a $79.95 package, and claims nearly universal font conversion. *AllType* (available in both DOS and Windows versions), converts, modifies, and installs fonts in such formats as Adobe PostScript Type 1, Microsoft TrueType, and Bitstream Fontware.

AllType performs bidirectional conversions while preserving the typeface's hinting information, maintaining clarity in the new typeface at smaller point sizes. A special feature allows modification of a font in over two dozen variations, and a customization feature lets users change a typeface's weight, pitch, italic angle, and leading. The package also provides automatic installation of fonts for applications in Windows 3.0 or 3.1, *GeoWorks*, *Ventura Publisher*, and *WordPerfect*.

List Price: *AllType* for DOS, $79.95; *AllType* for Windows, $79.95. **Requires:** DOS version: 640K RAM, DOS 3.0 or later. Windows version: 1MB RAM, Windows 3.0 or later. Atech Software, 5964 La Place Ct., #125, Carlsbad, CA 92008; 619-438-6883.

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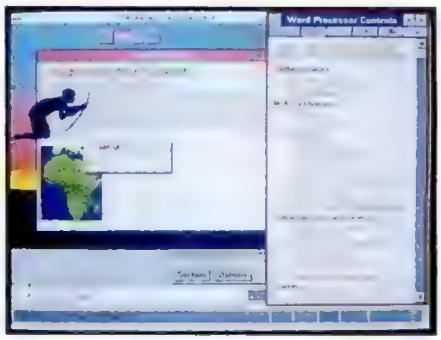
Works for Windows, Multimedia Edition

IMPROVED **Microsoft** has released its first multimedia business productivity application, *Microsoft Works for Windows, Multimedia Edition*. The $199 CD-ROM includes *Works for Windows*, Version 2.0, and adds digital sound, animation, and pictures to the tutorial and reference sections of the program.

During setup, an introductory movie gives users an overview of the program's word processing, spreadsheet, database, and drawing and charting functions as it guides them through the installation. The Online Tutorial is a collection of 42 lessons whose overviews are multimedia movies with sound and animation. The Online Reference section is accessible from anywhere in the program and can be viewed on-screen while working within the program.



The CD-ROM based multimedia help engine for this version of *Microsoft Works for Windows* is so comprehensive that Microsoft chose not to ship it with printed documentation.

List Price: *Microsoft Works for Windows, Multimedia Edition*, $199. **Requires:** Multimedia PC, DOS 3.1 or later, Microsoft CD-ROM Extensions 2.2 or later, Windows 3.0 with Multimedia Extensions 1.0. Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 206-883-8080.

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QuickPay 2.0 Manages Payrolls, Handles Deductions

IMPROVED **Intuit** is now shipping *QuickPay* 2.0, an add-on to its financial package, *Quicken*. The $59.95 add-on manages payroll accounts for multiple companies, allows users to set up deductions from, or additions to, employees' pay, and will automatically set up the accounts, categories, and classes when computing payrolls.

According to Intuit, *QuickPay* calculates all tax withholdings and deductions (including nine user-definable deductions) and fills in *Quicken* checks showing wages and deductions for that pay period and for the year to date. The program's built-in tax tables are updated by subscription to Intuit's Tax Table Update Service. ■

List Price: *QuickPay*, Version 2.0, $59.95. **Requires:** 512K RAM, DOS 2.1 or later, *Quicken*, Version 3.0, 4.0, or 5.0. Intuit, 1555 Linfield Ave., P.O. Box 3014, Menlo Park, CA 94026-3014; 800-624-8742, 415-322-0573.

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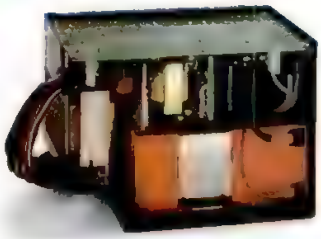

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edited by
Carol Levin

Read Only

Reviews of the Latest Books for the PC User

Excel Guide Promotes Good Spreadsheet Habits; Eases Transition to Windows

Spreadsheet programs have developed extraordinary capabilities. Yet most of us could probably still use the original *VisiCalc*; we harness so little of an advanced spreadsheet's power features. *Excel* 3—the leading spreadsheet program for Windows—is the perfect case in point, and it's a shame to think of all that raw power going to waste.

In *Using Excel 3 for Windows, Special Edition,* author Ron Person teaches beginning, intermediate, and advanced users to take full advantage of the program. At slightly over 1,000 pages, his book may not be much shorter than the original documentation (six booklets, including a 300-page function reference), but it's much more accessible. In one volume Person covers a full range of topics, from spreadsheet, database, charting, graphics, keystroke, and mouse control of basic commands all the way to customized restructuring of the *Excel* environment.

Person sets a brisk pace that follows a logically organized outline: Installation (including an orientation to Windows), Worksheets, Charts, Databases, Macros, and Advanced Techniques. The level of detail in each section is fairly involved. For example, the Worksheet section explores linked worksheets for consolidations; the Macros section has instructions for dialog boxes and customized menus.

One particularly special chapter is devoted to worksheet design. The advice offered here should be required reading for both novice and expert users who have spent more time repairing worksheets than they'd care to remember. Another memorable chapter is devoted to helping *Lotus 1-2-3* users make the transition from character-based computing to Windows-based *Excel*.

Using Excel 3 for Windows is clearly written and has plenty of examples. A few of the exercises are thin, but others demonstrate some genuinely useful ideas. The book is attractively designed, with lots of screen shots (though they are reproduced a bit too small), scholars' margins, and the judicious use of a second color on every page to highlight section headings and keystrokes in examples, and to draw attention to the numerous tips that are sprinkled throughout the book.

The book's shortcomings—a few typographical errors, repeated lines in tables, and missing information—are fortunately few and far between, and none are serious enough to derail most readers. In spite of the book's length, some advanced users may find that the explanations of some functions and macros don't go far enough.

For most users, though, *Using Excel 3 for Windows* is a good source for getting to know this powerful program and for gaining a new appreciation of all it has to offer. After working through just the first handful of chapters, you'll be well on your way to taking full advantage of *Excel*.—*Alfred Poor*

Using Excel 3 for Windows, Special Edition
by Ron Person, $29.95, Que, Prentice Hall Computer Publishing, 11711 N. College Ave., Carmel, IN 46032; 800-428-5331, 317-573-2510. ISBN 0-88022-685-4.
CIRCLE 403 ON READER SERVICE CARD

Quattro Pro Handbook Condenses Pounds of Guidance in a Single Source

Quattro Pro 3.0 is a heavyweight contender in the spreadsheet marketplace by any measure. Even the box and manuals weigh in at about 6 pounds. So why would anyone need an extra book about the program, especially one as hefty as Mary Campbell's 900-page *Quattro Pro 3.0 Handbook*?

The answer is simple. If you want to learn how to use the program beyond simple row-and-column calculator work, and you don't relish the thought of wading through the three volumes of documentation that come with the program, you'll want this book.

The first in a series of Borland/Bantam titles, *Quattro Pro 3.0 Handbook* tackles an ambitious scope with ease and economy. Campbell starts with basic spreadsheet operations such as navigation and printing but rapidly picks up the pace with in-depth chapters that cover file import/export and the various calculation functions. By grouping the functions by category rather than alphabetically, the author makes them easy to find and clarifies the distinctions among similar functions, such as the three different depreciation methods.

Later chapters detail *Quattro Pro*'s graphics and slide shows, database management features, statistical analysis functions, and customization. In addition, there are over 100 pages devoted to a full range of macro capabilities.

Campbell ends each chapter with a section paradoxically titled "Getting Started." This refers to the reader, though, not the chapter. While far from comprehensive, these tutorials include step-by-step instructions that take you through a number of tasks that illustrate the features and concepts covered in that chapter.

You would expect the publisher to show off *Quattro Pro* 3.0 at its best, since the book has Borland's blessing (CEO Philippe Kahn wrote the foreword), but one of the weakest points of the book is the production quality. The print quality is uneven, and nearly all of the sample screens are full-screen images that are less helpful than an enlarged and cropped detail of just a portion of each screen would be. The full-screen approach is visually repetitious, and the sample graphics and screens are frequently coarse and hard to read. Still, the production quality only slightly diminishes the book's value.

Campbell doesn't write for everyone. Her quick pace may leave a novice bewildered and power users hungry for greater detail on macros or other arcane arts. But for the rest of us in between, this handbook teaches how to make the most of *Quattro Pro* 3.0.—*AP*

Quattro Pro 3.0 Handbook, 3rd Edition
by Mary Campbell, $29.95, Bantam Computer Books, 666 Fifth Ave., New York, NY 10103; 800-223-6834 (ext. 9479), 212-492-9479. ISBN 0-553-35486-8.
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Read Only

Dvorak's PC Buyer's Guide: Caveat Emptor

At first glance, the *PC Magazine 1992 Buyer's Guide to PCs, Printers, and Monitors* appears to be a one-stop source of information. Editor John C. Dvorak offers excellent hardware advice to help you choose the right system.

Chapters written by the editors of *PC Magazine* arm the PC buyer with useful background on systems, components, and peripherals. You'll get a quick rundown on microprocessors, expansion buses, and video adapters; an overview of printer, monitor, modem, and input device technologies; and favorite choices in the portable market. There's also a comprehensive, up-to-date directory of over 600 PC product manufacturers.

Roughly two-thirds of the book consists of product evaluation tables that recap two and a half years of *PC Magazine* features tables. Unfortunately, this is where the book falters.

What was relevant in a product review six months ago, let alone two and a half years ago, is most likely archaic today. Many of the listed products—even Editors' Choices and Dvorak's Picks—have been discontinued, or their specifications and prices have changed significantly. One example, the Zeos 386/33-MHz PC, now has a different BIOS, allows for an additional 24MB of RAM on the motherboard, and costs $2,000 less than the listed model. Likewise, many of the recommended VGA monitors have been discontinued or replaced by improved, less expensive models. Also, products in more recent *PC Magazine* roundups are not all covered. For example, Dvorak looks at the 25-MHz 486 PCs from the June 25, 1991, issue, but he excludes the coprocessed video adapters from the same issue.

In the end, the high-quality advice and knowledgeable editorial insights do not compensate for the features tables filled with dated product information. As the Latin proverb says, "Caveat emptor."—*Brent Heslop and David Angell* ■

From Dvorak's PC Buyers' Basics:

Don't look for the cheapest system you can live with, but the best system you can afford. Spend a couple hundred dollars more for a 25 MHz 386 instead of saving some bucks by buying an SX. Over the long run it will save you money because you'll get an extra year of useful life from the system.

Don't be afraid of mail order. Mail order companies have become a major part of the industry. They couldn't have done it if they weren't offering a worthwhile service . . . . Be smart, and you'll end up with a good PC at a great price.—*PC Magazine 1992 Buyer's Guide to PCs, Printers, and Monitors*, pages 9–10.

PC Magazine 1992 Buyer's Guide to PCs, Printers, and Monitors

edited by John C. Dvorak, $19.95, Ziff-Davis Press, 5903 Christie Ave., Emeryville, CA 94608; 800-688-0448, 415-601-2000. ISBN: 1-56276-004-1.

CIRCLE 405 ON READER SERVICE CARD

Brent Heslop and David Angell are partners in Bookware, a technical writing firm. They write a book review column for Computer Currents.

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edited by
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Toolkits

Reviews of the Latest Tools for the PC Programmer

PowerBuilder: An Ideal Tool for Creating Windows Front Ends for SQL Servers

Developing front ends for client/server database applications is slowly becoming the next programming frontier, especially in the corporate environment. Combine this with the increasing popularity of Windows 3.0, and you have a market for Windows-based development kits for database servers waiting to be tapped. With PowerBuilder, a pricey but powerful object-oriented developer's toolkit, PowerSoft Corp. plans to do just that.

Aimed primarily at the corporate and MIS applications programmer, PowerBuilder is unique in that it is a programming toolkit rather than an extension to an existing database application. The initial release supports *Microsoft/Sybase SQL Server* and other Sybase servers, Gupta Technologies' *SQLBase*, and *Oracle Server* from Oracle Corp. At press time, PowerSoft said that interfaces for *XDB*, Hewlett-Packard's *ALLBASE/SQL*, and IBM's *DB2* were being tested. The developer's package comes with support for one server; additional interfaces are available at extra cost. The minimum recommended system requirements are a 386SX with 2MB of RAM and VGA.

PowerBuilder has no native database manager and requires that you connect to a database server to build and test applications. It takes full advantage of the Windows 3.0 environment; all development is done through *painters*, the name PowerSoft has given the various modules you use to create a database, define menus and screens, manipulate the data, and develop, debug, and maintain applications. While the modules' icons are displayed separately on the main menu, they're also tightly linked, and can be executed from within each other as the need arises. Underlying all the modules and tying the development environment together is PowerScript, PowerBuilder's C-like script language. Applications are stored in proprietary-format libraries that contain the tokenized script and object definitions.

While prior knowledge of C or SQL programming isn't necessary to create applications in PowerBuilder, an understanding of Windows' event-driven nature makes the development process easier. However, PowerBuilder's manuals do discuss these concepts briefly and include many examples of the proper use of PowerScript statements and functions.

CREATING APPLICATIONS

After installing PowerBuilder and the appropriate database server interfaces, the next step is to set up the development environment. Using the Preferences module, specify the vendor and name of the database server you will use, log-on IDs, passwords, the graphics design program to be called by the Picture Painter menu choice, and default applications and libraries. Then, using the Database module, connect to the database server and create the database itself. You have full control over the database from here and can create, alter, and delete tables, create and drop indexes, and specify validation rules. Picture formats used to display the data in each column are also defined here.

Once the tables are created, you can create a view by linking two tables and highlighting the columns in each table that will be included in the view. PowerBuilder makes excellent use of Windows graphics throughout the entire development process. For example, a key icon is attached to the appropriate columns to indicate what the table is indexed on, and a view icon is connected to the tables that are part of a view. You can also associate bitmaps (created externally or through the Picture Painter) with a column in a database, regardless of the database server. A bitmap's filename is stored as data in a column and acts as a pointer to the actual bitmap; the bitmap is displayed by PowerBuilder when the row is retrieved.

The database server can also be administered through this module; you can enter SQL statements that are sent directly to the server to maintain users, groups, and security, and execute stored procedures (if supported by the particular database server). PowerBuilder makes it easy to create common SQL statements through the SQL Painter, which builds the statements through point-and-shoot windows, and can include SQL sorting and data filter functions.

Next, use the Applications Painter to name the application and its associated libraries, and assign an icon to it. Then use the Window Painter to create the applications interface, using the full range of Windows objects, such as check boxes, command buttons, radio buttons, scroll bars, and list boxes. The actions associated with these objects are executed by custom PowerScript scripts. You can use the Menu Painter to create the application's overall menus. And you can choose the Picture Painter to create custom icons that become part of the application's interface when associated with particular actions.

The DataWindow Painter is the most powerful feature and the heart of PowerBuilder. Using it in combination with SQL statements or PowerScript scripts, you can retrieve and manipulate one or more rows of data from the database server. Window Painter lets you display data in tabular rows or in a free-form window; SQL Painter lets you custom-write or build statements; PowerScript Painter lets you create script files, drawing from over 70 built-in functions; and Function Painter lets you create user-defined functions. Full DDE (dynamic data exchange) support is included, and external Windows or database server library functions can be called from within a script.

Finally, you can compile your application into a runtime program using the built-in compiler.

Database server front ends are usually sold as extensions to existing database programs, which restrict you to that program's interface. PowerBuilder doesn't suffer from this limitation: It's a powerful and complete front-end development toolkit and compiler, almost equivalent to the C or Pascal compilers used to create character-based applications. As such, it's ideal for corporations that are interested in creating a Windows-based front end for their mainframe, mini, or LAN-based database servers.—*Joe Salemi*

***PowerBuilder*, Version 1.0.**
List Price: *SQL Server, Oracle Server* versions, $2,995; *Gupta* version, $1,999; additional interfaces (*SQL Server, Oracle Server*), $995; (*Gupta*), $695; runtime modules, $200 per user.
Requires: 386SX or better, 2MB RAM; DOS 3.3 or later; Windows 3.0; LAN with supported database server. PowerSoft Corp., 70 Blanchard Rd., Burlington, MA 01803; 617-229-2200.
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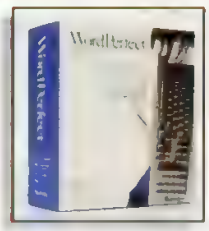

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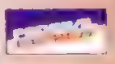

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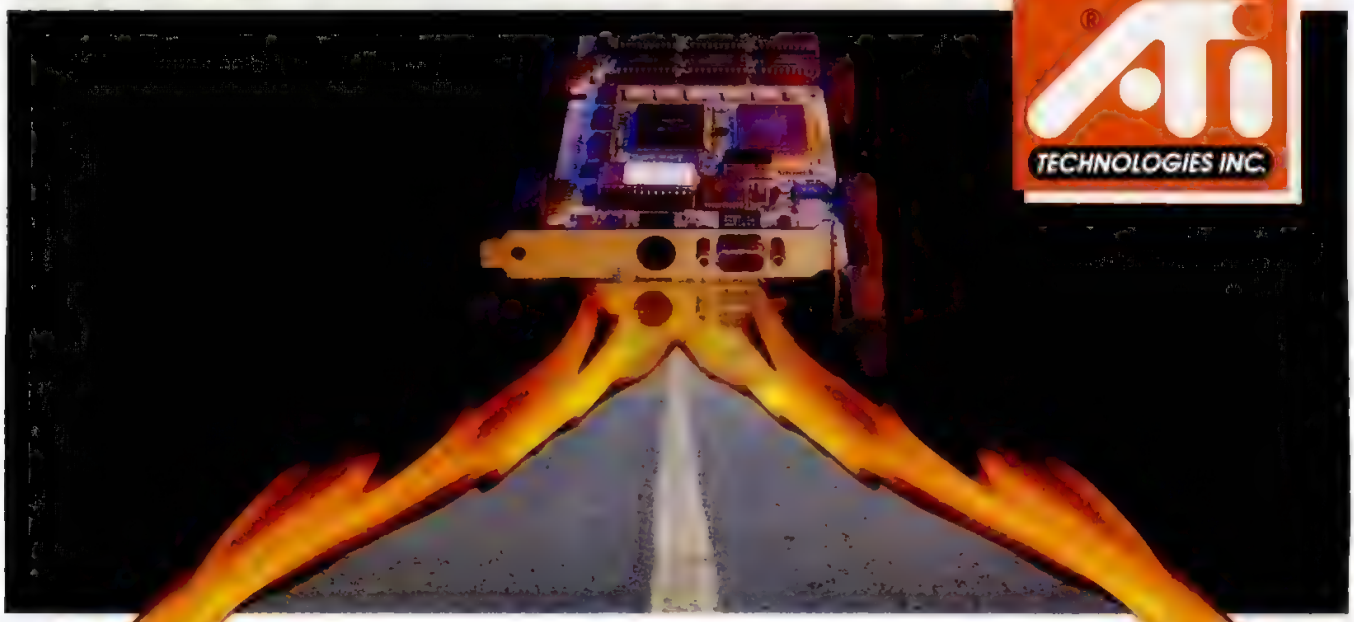

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CIRCLE 337 ON READER SERVICE CARD

Michael J. Miller

Communicating A Document: Not by Text Alone

We need a way to transmit documents intact, including fonts, graphics, and formatting. Faxing is a start; something more is needed.

Communicating information from place to place is an integral part of modern business. Traditional electronic mail systems let you log on when you're on the road and make it easy to pick up your messages and perhaps any relevant files. Certainly a much better alternative than mail connections, voice mail, or playing telephone tag. But it's still a long way from perfect.

Most systems today only let you transmit ASCII files. These files contain text, but lack some of the other things that contribute to the integrity of a document: fonts for emphasis, graphics or drawings, and text formatting. Of course, you could send the actual program files across most systems, but that only works if the person on the receiving end has a compatible program, and provided that the person you are trying to reach uses the same e-mail system as you.

Lately, many software companies are looking at different ways of handling these problems. Nothing has been resolved yet, but they are pointing in the right direction.

One alternative to traditional electronic mail is fax systems. In addition to using conventional fax machines, you can send a fax electronically via a service like MCI Mail, but you can't receive faxes that way. Nor can these services include the fonts or graphics you might use on a modern word processor.

On the other hand, dozens of companies market fax boards and fax modems for PCs. There's quite an array of software that works with these boards now, making it easy to at least send fax messages from a PC. Sending a PC-based fax is a great solution if you are trying to reach someone who hasn't yet discovered the joys of one of the nationwide electronic mail services, if you can't connect with someone's e-mail system, or if you want to send more than just plain ASCII text. Besides, dedicated fax machines are ubiquitous in corporate America today.

One of my favorite recent solutions is a program from Delrina Technologies called *WinFax PRO* ("Good Things Get Better: *WinFax PRO* Expands Fax Modem Support," First Looks, December 17, 1991). This Windows utility lets you send faxes from any Windows application by acting as a printer driver. It also lets you receive faxes, convert the Group III Fax images to .PCX or TIFF files, and print them.

I've used *WinFax PRO* with Macronix's MaxLite external portable modem, a 9,600-bps fax/2,400-bps data modem that's about the size of a deck of cards. It's a great device, powered either by an internal battery or by AC power, though I suppose I'd love to see the modem draw its power from the PC itself. The software/hardware combination makes it easy to fax a message even from a portable computer.

NO CHANGES ALLOWED

Faxing gets the job done but it has some limitations. The biggest of these is on the receiving side, where the document comes in as a graphics file. Essentially, you can't edit it or easily store its information in a spreadsheet or database.

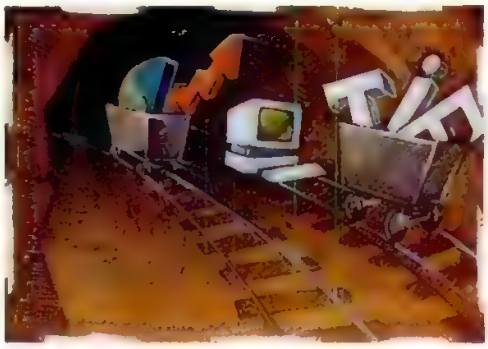

ILLUSTRATION: JOHN LABBE

Addressing this concern, Delrina has recently agreed to acquire OCR Systems, the maker of the *ReadRight* character recognition program, as well as a related company that is working on neural network technology designed to improve character recognition.

Imagine an OCR utility that could take an incoming fax and translate it into characters

that you could then edit and resend or place into a word processor. Delrina is talking about combining its fax utility with intelligent OCR for less than $300, which just might make fax transmission a more popular way of transmitting information.

Other alternatives, ones with even broader goals, are on the horizon. Adobe Systems has been demonstrating its vision of a new technology for document communications.

In its demos, Adobe shows how you create a document (including fonts and graphics) on one machine and send it to another machine and have the document look exactly the same—even if the receiving machine doesn't have the same fonts. This works even if you create the document on a PC and receive it on a NeXT machine or a Macintosh.

Adobe's technology builds on much of what it's done before—the PostScript page description language, which defines how pages should look, and multiple master typefaces, which can mimic the look of typefaces even when they're not present on the receiving machine. So far Adobe's efforts are just an unnamed "technology direction," but you know a product is on the way. I can see lots of uses for this kind of a standard in viewing information, such as in the emerging CD-ROM software market, where large amounts of data are delivered to various system configurations.

EDITABLE TECHNOLOGIES

Whether Adobe's proposed new format or the existing fax format becomes a standard for transmitting files with fonts and graphics, there's still one missing ingredient. What we really need is to be able to transfer documents from one machine to another in a form that is *editable*, so that fonts and graphics appear the same on both the sending and receiving machines.

OCR technology is one step in the right direction, but it doesn't have perfect translation and it doesn't really handle fonts or graphics. Adobe says it hopes to be able to make its format editable, but hasn't demonstrated that yet. Still, it's something to look forward to.

In the meantime, perhaps a less ambitious solution would solve many of our current document communications problems.

Today, if you have a word processing, desktop publishing, or spreadsheet program and you try to import a document created in another application, you often get only the raw text. Why can't we just ask the software developers to improve program import/export capabilities so that all the fonts, graphics, and other information transfers along with the data? It's not as complete a solution, but it sure would be a great start.

We could then get ready for more sophisticated ideas in the next few years. Improved on-the-fly character recognition would certainly aid communication, as would file formats that let you replicate a document exactly on anybody's machine—and still let you edit its contents. After all, the real content of a document is not just the text or its look, but the combination of the two. ■

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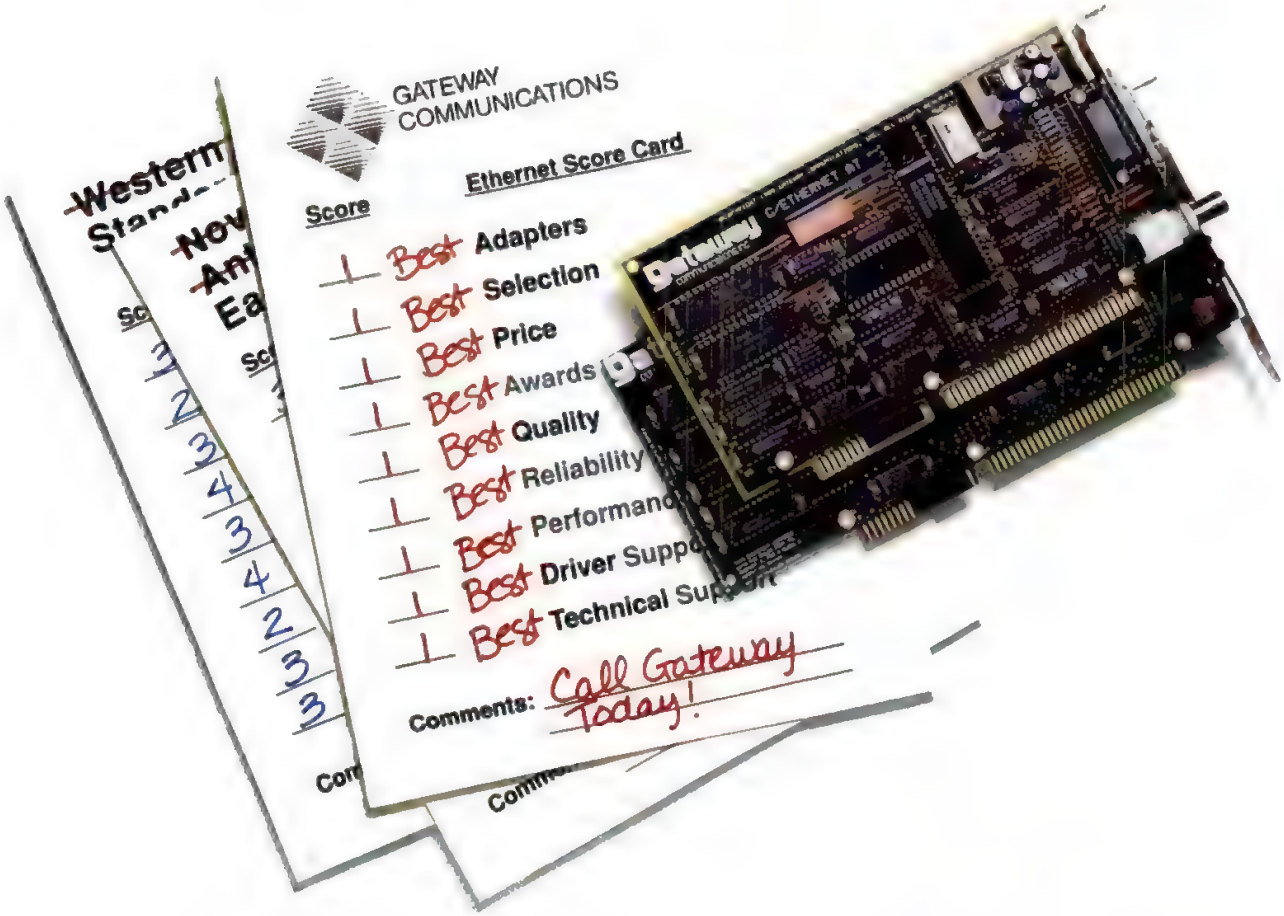

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Bill Machrone

Special-Purpose Software

As the big packages add more and more features, software designed for specific tasks still runs rings around them.

Two hundred million years of evolution brought dinosaurs close to perfection—at being dinosaurs. They could hardly comprehend, much less react to, the mammals scampering between their legs. So it is with today's mainstream packages and the teeming masses of "little" applications buzzing around them. Unlike geological history, however, there is no computer software cataclysm coming that will bring an end to the big guys. They'll continue to evolve and fill their roles in the personal computing environment. But they'll never fill up all the niches and interstices occupied by the little guys.

Special-purpose software has been admirably served, and will continue to be, by the shareware community. Shareware remains the least expensive way to get into the software business, and the widespread popularity of on-line systems, bulletin boards, and shareware distribution companies has made it a big little business.

Shareware has also overcome some amazing obstacles and prejudices to take its rightful role as the premier way to distribute low-cost, special-purpose, and low-volume software. I've heard mid-level managers, corporate lawyers, and buyers say that they couldn't allow their companies to buy shareware for the darndest reasons, including the inability to order it via a purchase requisition, the implicit permission to distribute (and pay for) additional copies, and the supposed danger of picking up unwanted computer viruses.

LABELS WITHOUT TEARS

Other companies have gone mainstream with special-purpose software. One of my favorites is PowerUp! Software (800-851-2917, 415-345-5900), which publishes a catalog of handy programs that address very specific needs. My favorite PowerUp! utility is *LabelPro* 3.0, which is the best label-printing program I've seen by a considerable margin. For starters, *LabelPro* knows about every commercial label, by manufacturer and style number. Disk labels? File folder labels? Name badges? Bring 'em on.

Want to do three-up laser-printed labels? No problem—just tell *LabelPro* that you've put Avery 5160s into your printer. It lets you control the type font, size, and style line by line, not just for the whole label. It lets you embed .PCX graphical images wherever you like on the label. It has a zoomable graphics preview mode that lets you see what the page will look like. It also has a terrible user interface, but one that's worth putting up with just for the features.

The database manager in *LabelPro* is its greatest weakness, offering next to nothing in searching, sorting, or indexing. You wind up doing your data management outside, then importing the records into *LabelPro*. Of course, it uses a proprietary data format, so you can't operate on its files directly.

Lots of database programs will do a great job printing labels. I've seen some terrific spreadsheet macros to do it, and even some multicolumn mail-merges for high-end word processors. But I'll take *LabelPro* over any of them.

BOOKS WITHOUT DTP

Another favorite comes from Korenthal Associates (800-527-7647, 212-242-1790): *4Print*. Let's say you've downloaded a program and want to print the documentation. Or you're a

ILLUSTRATION: JOHN LABBE

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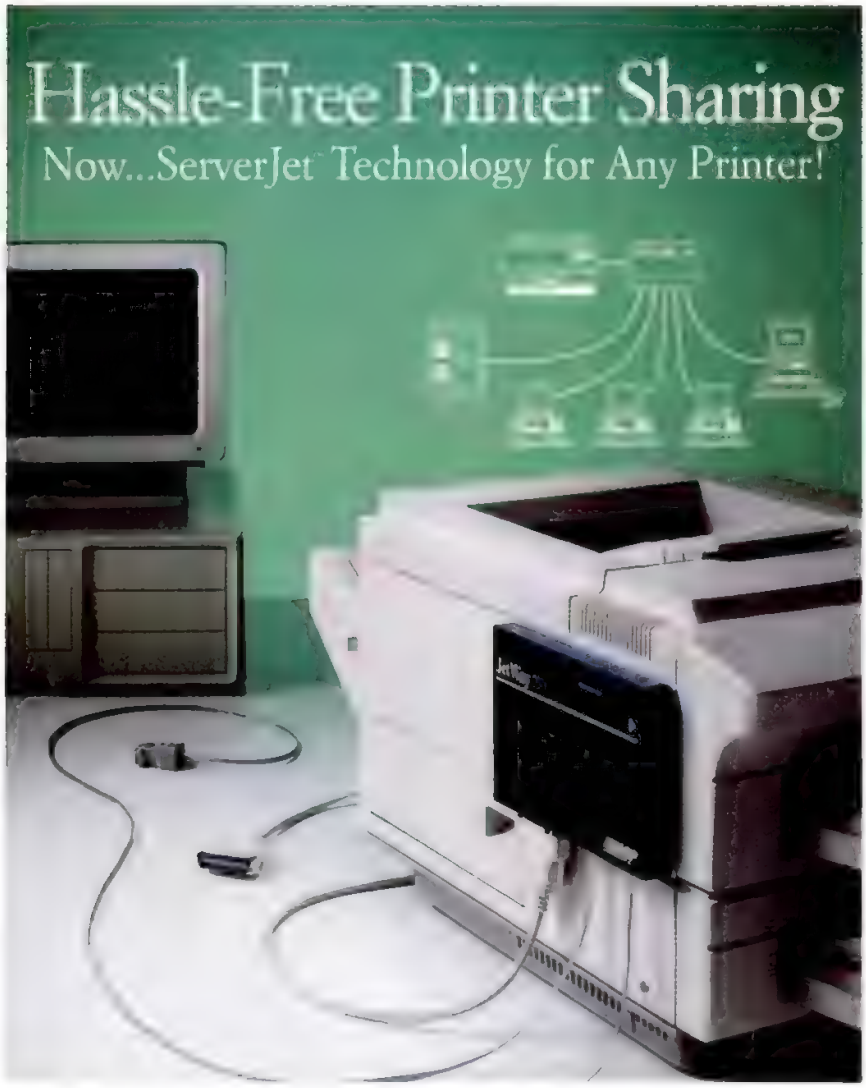

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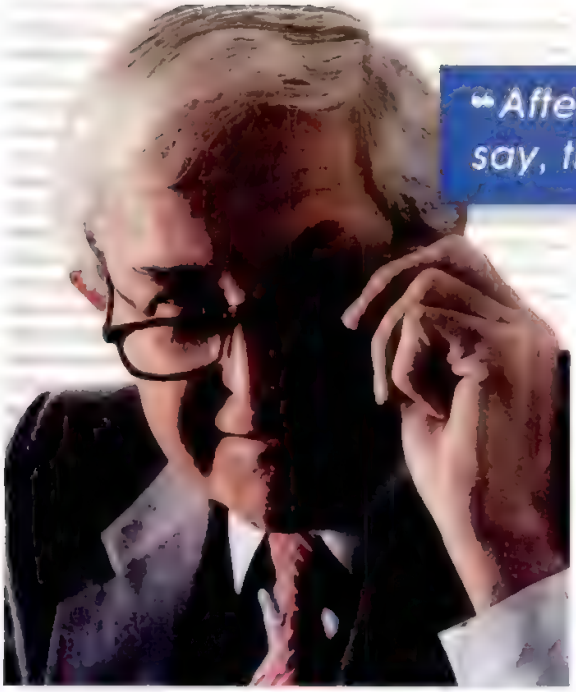
4Print's companion product, *4Book*, turns your ASCII documents into nifty little 5.5- by 8.5-inch booklets, ready to be cut and bound or saddle-stapled. This is a great way to print and store documentation, but you'll drive everybody else at work wild when you show up at a meeting with a custom, self-contained briefing book. It's way cool, and it has too many cute and useful features for me to mention here.

USER INTERFACE FROM HECK

I mentioned *LabelPro*'s terrible user interface. Well, at least it has one. *4Print* is driven entirely from the command line, a fascinating anachronism in this day of friendly programs. It's not that it's hard to use, but there's nothing intuitive about typing "4print myfile.doc -bn1,,,3 -d -tiny -bu -zw."

4Print does have an extensive help file that explains each command just as well as the manual. But you have to jot down your selections and type them properly rather than select them interactively while the help information is displayed. Another shareware program to the rescue. *4Shell* is a Windows program from Korenthal that allows you to set *4Print* options with radio buttons and check boxes—and still gives you access to the command line if you're hard core.

While the software dinosaurs are in no danger of extinction, these and other special-purpose programs will continue to prosper. Check 'em out; you'll be glad you did. ■



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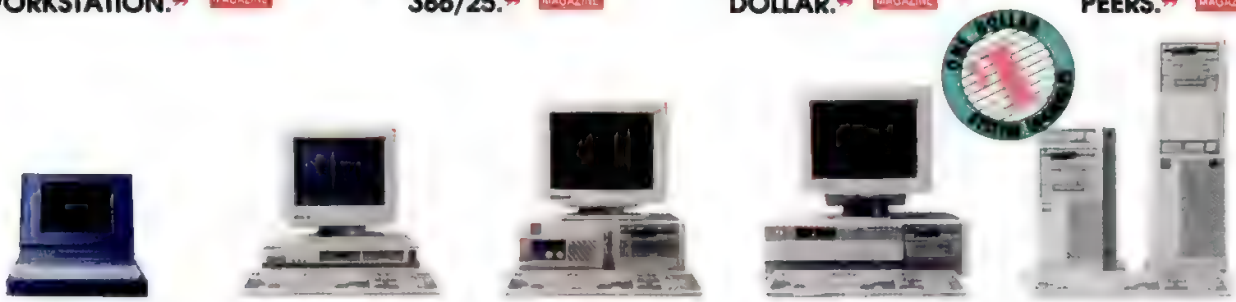

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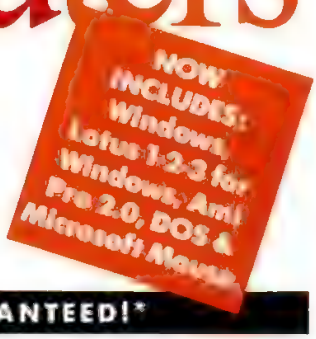

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CIRCLE 722 ON READER SERVICE CARD

John C. Dvorak

Dvorak's Annual Comdex Analysis

Networking, multimedia, and the home market are heating up, but is the industry cooling off?

Every year I like to see what industry trends can be spotted by evaluating the Comdex Program & Exhibits Guide and comparing its contents with those of previous years.

The 1991 guide marks a time of stabilization; the book size stopped growing. The previous year's record (654 pages) remained intact as the 1991 guide hit 622 pages. 146 pages of the 1991 guide were devoted to conferences, compared with 120 pages in 1990. So the conference/exhibitor ratio may be changing, too.

The last major downturn in the number of guide pages was in 1983, marking a two-year decline in the business. I suspect that this phenomenon is repeating. Next year's show may shrink further.

Anyone attending Comdex would find it hard to conclude that the business was off, though. The show was packed. Overlooked is the fact that there seemed to be more overseas attendees than in years past. I was stunned at the number of showgoers who were from South America alone.

Let's look at some of the product trends we can extrapolate from the catalog.

Most significant was the complete elimination of the major product category Data Communications. To make up for it, the show added a slew of new networking categories including e-mail, security, cabling(!), and 22 others, including the subcategories that were once under the excised Data Communications group. I think this usurpation by networking was partly an attempt to take some steam away from Networld the week before. It also marked a new show emphasis. I suspect this category will be further bloated next year. An analysis of the exhibitors showed that out of 1,905 exhibitors (as calculated from the data disk handed out with this year's guide), a whopping 584 could be related to networking.

On the other hand, there seems to be a subtle consolidation after the LAN mania of the past few years. In 1990 the new category of LAN Boards appeared, with 79 exhibitors. This year it dropped to 62 exhibitors.

Surprisingly, the category of "Computers: workstation" was eliminated. This was curious, since the category had jumped from 50 in 1989 to 110 last year. Workstation seems to be a term going out of favor.

Added to the catalog was a new section called multimedia, with 11 new categories, the largest being AV boards and component makers, with 38 entries, followed by Image/Art libraries, with 35 exhibitors. Clip art has found its way into Comdex as multimedia. Gads!

The continually growing category of Office Automation hit 60 entries in 1991, up from 49 the previous year. In parallel, the computer security group went from 18 in 1990 to 31 in 1991. Network security had 39 exhibitors. These trends are clear.

Board makers went flat in 1991 with almost identical numbers from the previous year. Other areas of flat growth were surprising. In 1990 there were 131 exhibitors categorized under laptops, and in 1991, again 131. The clone market has also stabilized.

Perhaps the most surprising exhibitor group was the new entry Home Computing, with 19 exhibitors. This is something I thought I'd never see at Comdex since the death of IBM's PC*jr*. I suspect this will not continue for long.

ILLUSTRATION JOHN LABBE

So we have an interesting set of trends: continued networking growth, the birth of multimedia, and the reemergence of the home PC in a relatively flat clone market. These are discrepant trends, and I believe the show will have to concentrate on one or two, lest segmentation ruin its focus. The new emphasis on networking in the guide and pitting Comdex against Networld makes it obvious what the primary direction will be: networks.

Last time, it was the experts' choice. This time, it's the easy choice.

The new IRMA WorkStation for Windows 1.1

From the very beginning this 3270 emulation software was the No. 1 choice of experts like the editors of *PC Magazine*. It brought a host of sophisticated features into the wonderful world of Windows™ connectivity. But it was only the start.

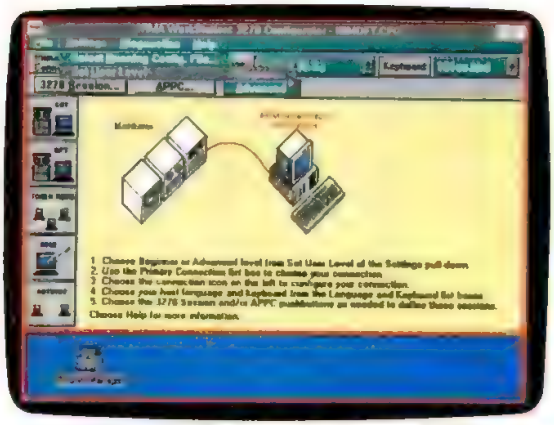
PC MAGAZINE EDITORS' CHOICE

February 26, 1991 IRMA WorkStation for Windows, Ver. 1.0.

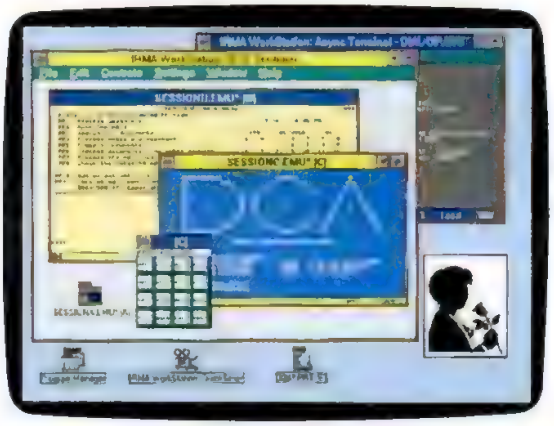
Now, we've made IRMA™ WorkStation for Windows so incredibly simple to install and operate, that it's the easy choice for anyone!

The new 1.1 version virtually installs itself. Instead of asking endless questions during "SET-UP", it senses your communications adapter and then pre-configures the software accordingly. Say you have an IRMA 3® Convertible coax card. With the "Intelligent User Assist" program it will automatically pre-configure the CUT and DFT connections. If you have an IRMAtrac™ token-ring adapter, it will pre-configure a token-ring connection.

Once installed, our new software is easier to operate, too. Using the familiar Windows Multiple Document Interface (MDI), you get the easy efficiency of managing multiple sessions with a single menu bar.



Installation couldn't be easier! The new Intelligent User Assist automatically senses the communications adapter in your PC. A Configurator Screen shows your PC and its connection to the mainframe.



Multiple Document Interface (MDI) lets you manage multiple communications sessions with a single menu bar in the main 3270 terminal emulation window.

Integrating mainframe data into your other Windows applications is no problem either. You'll find a breadth of application integration tools like macros, QuickScript™ with DDE, HLLAPI and APPC.

Just as important, with this IRMA software package, you can get into "Windows" connectivity no matter how you're connected. There's CUT, DFT, SDLC, token-ring and asynchronous connections. And what's more, IRMA WorkStation for Windows can now even act as client software for DCA®'s IRMALAN™/*EP* 3270 NetBIOS gateway. No one offers as many connectivity options!

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CIRCLE 389 ON READER SERVICE CARD

John C.
Dvorak

Inside Track

I suppose that **nothing** in the last year surprised me more than IBM's getting back into bed with Intel after doing deals with Apple and Motorola. It takes some thought to determine what might be behind the decision. According to the press reports, the two companies will **jointly develop processors;** some of these will incorporate the **XGA** graphics engine. It was made clear that there would be no exclusive deals, however. These developments will be part of the normal new arrangements being made by Intel.

When I first read of this IBM/Intel agreement, I wondered what the point behind it was. After all, IBM could sit in the back and just take what Intel had to offer and accomplish pretty much the same thing. Did IBM believe that Intel would slow down its already **frantic** development pace? And if IBM is working with Motorola and Apple to develop the RISC workstation of the future, what is the point of aiding the CISC camp this way? It makes no sense.

At least that's what I thought until I read a **gossip item** that claimed Microsoft bullied the Windows Presentation Manager Association into **dropping the "Presentation Manager"** moniker and any OS/2 association. At Microsoft's bidding, it's becoming a special interest group (SIG) of the Software Publishers Association as the Windows Developers SIG, or some such thing. I believe that Microsoft is **amusing itself** by pulling the rug out from under IBM every chance it can. IBM seems so helpless by comparison.

> IBM is sending people to 47th Street Photo to find out what's new in the DOS world. This is not confidence-inspiring.

IBM worsens its image with uninspired public displays. A friend of mine dropped off a tape of the IBM OS/2 demo at last year's PC Expo. At one point the speaker, who seems **bored stiff** by it all, says, "We ran down to 47th Street Photo to see what's new in the DOS world." Later he again talked about going to 47th Street Photo to get something. Is this the way the new IBM does research? Gads. I'm sure the price is right at 47th Street Photo, but **isn't this a bit odd?** The company has over 350,000 employees—more people than the population of a small country—and it's sending people to 47th Street Photo to find out what's happening in the DOS world. This is **not** confidence-inspiring.

On the other hand, IBM is trying to be as **scrappy** as it can. But like a lot of large successful companies, IBM is having trouble maintaining the edge it once had. It's almost **passive** compared with Microsoft. But obviously it's a company with pride, and surely the upstart Microsoft cannot win every skirmish. Furthermore, IBM does know chip technology and is aware that Microsoft has been "helping" Intel with suggestions over the years. By joining forces with Intel, it's possible that **IBM can derail some of Microsoft's long-term OS strategies** and make future Intel designs more OS/2-friendly. There is **no other explanation** for this deal.

The Battle of the Titans Dept.: With Fujitsu owning a good piece of Poqet Computer Corp., we can expect to see the Japanese manufacturing prowess drive down the price of full-keyboard palmtops. In the meantime, Sharp Electronics (800-237-4277) has been showing its new PC—the 3000 Palmtop, a **1-pound clone** of the Poqet. Expected to sell for about $1,000 as an executive's PC and marketed directly through corporate channels, this machine combines the features of the Poqet and the HP palmtop and now appears to be the definitive palmtop. I haven't been a fan of this type of machine to date, and now I'm wondering how much of that opinion was based on aesthetic considerations. It's **a work of art,** and I like it. Get a demo.

Who Are They Kidding Dept.: While **software rental** agencies have been shut down by the SPA, one company in San Antonio—All Systems Go—has circumvented the system by offering installment buying of software. Make no mistake, it's the same thing with a different style. The appeal is simple. You pay a fee, take the software home, copy it, and take it back. The giveaway is that the "installment" payments are made every two days! **Modern piracy?** Or a software version of videotape rental? From the company flyer: *You may purchase software via an installment contract. By making only the first payment on the installment contract you may purchase any software in the store. If you are not happy with the software you may return it before the next payment is due. You lose only your first payment, and the contract is canceled with no further obligation to you.*

Interestingly, the contract for the new club has a provision that the club members returning the software **must erase** all copies from their hard disk. Of course, this is **impossible to enforce** unless the SPA obtained a customer list and search warrants, an unlikely thing to happen. This concept could become rampant if it isn't stopped somehow.

CompuServe Fights Back Dept.: In a market test, CompuServe began offering select customers a new "basic" CIS package for $7.95 per month, which includes $9.00 worth of free e-mail. For the minimum fee you get news, weather, stock quotes, the American Airlines SABRE reservation service, and **just about everything you get on Prodigy.** If the test is successful, CompuServe will roll out a massive program promoting the new service. Looks hot. ■

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CIRCLE 187 ON READER SERVICE CARD

Jim Seymour

Momenta Mori. . . .

While the Momenta PC may have the breadth of features for the corporate Everyman, its lack of focus helps no one.

Focus, focus, focus. That's the PC-business equivalent of the old realtor's line about what determines the value of a piece of property: location, location, location.

Companies that have prospered have done so by spotting an unfilled market niche, then building a program or piece of hardware optimized for that niche. Over time, successful PC companies go on to define a whole series of product inflections to fit within that niche.

It's easy to think of products that have come to market with less than that precise focus, and died as a result. Remember *Context MBA*, another "integrated" program introduced at the same time as *Lotus 1-2-3*? It looked as if its breadth would make *it* the biggest-selling program ever—but it got steamrollered by *1-2-3*. The people at Lotus positioned *1-2-3* as a hot spreadsheet that happened to have some graphical and database functions along for the ride. The success of the pioneering computer spreadsheet program *VisiCalc* in the Apple world, and delays in moving *VisiCalc* to the PC, had created a huge vacuum for a hot PC spreadsheet. Lotus won big; *Context MBA*'s greater versatility (and sluggish performance) made it a trivia contest answer.

I think we're about to see that same lack of focus bring down another wannabe high-flyer in the PC business. Momenta has certainly been the high-profile, high-concept, high-PR winner of the last half of 1991.

A well-known computer entrepreneur starts a new company in the pen-PC field—itself a highly visible market-to-be, full of ferment, hype, and possibilities. High-tech venture capitalists flock around, with generous capitalization. High-powered public relations dribble out ever-more-enticing niblets of information. Exceptionally attractive, high-concept preproduction units draw oohs and aahs. A massive model of the computer, complete with poised human hand, flies high over the crowds at Fall Comdex.

Finally, an amazingly opaque and self-conscious ad, right out of the Nissan Infiniti School of Obscure but Undeniably Hip Advertising, appears in computer and business magazines. In it, a devil-may-care fellow who looks like he just wandered in from a *GQ* shoot lies sprawled on the floor, playing with his Momenta.

Yeah, man. Like wow.

Momenta's USP, or unique selling proposition (and it does have a doozy of a USP), is that this machine is neither fish nor fowl. Or maybe, it's *both*. Because the Momenta gimmick is that it's both a pen PC and also a standard keyboard-equipped PC.

Focus, people, *focus*.

Actually, Momenta's answer is that it has focus by the ton. This machine isn't for the sweaty, blue-collar masses for whom most pen PCs are in theory being created. No Frito-Lay route driver is going to manage his accounts and the inventory on his delivery truck with a Momenta PC.

Nope, the Momenta is for executives—and more, for those now nearly legendary Executives Who Still Don't Use PCs. They can use a stylus when they want (or if they're still afraid of keyboards), and they can use a keyboard when that's more appropriate. So goes the party line.

Another way to see the Momenta is that it's a bet against a real pen-PC market happening.

ILLUSTRATION: JOHN LABBE

That line goes like this:

Well, there aren't any real pen-PC applications out there yet, so in the meantime you can use the machine with its keyboard, just as you would any notebook PC. Then, when pen apps become available, you can switch over to using it as a stylus-entry machine.

C'mon, guys: *Focus!*

I can't think of a single case where a computer or a piece of computer software that tried to fit both sides of a very opposite equation

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CIRCLE 479 ON READER SERVICE CARD

succeeded. There are already great notebook PCs and there will be many more; there are good to very good pen PCs coming throughout 1992. But the market isn't asking for a Swiss Army knife job.

There may, in fact, be a relatively small market, eventually, for "executive" stylus PCs. I haven't yet met the executive who'd buy one, and I work with and speak to thousands of corporate executives a year, but I don't deny that there may be some of them out there somewhere. If they do exist in sufficient number to constitute a viable market, I'm as sure as I can be that they're not looking for a half-stylus/half-notebook PC.

DANGER: RUG BURNS

There are lots of other things wrong with the Momenta. It has an innovative, squirrelly, confusing, and hard-to-navigate proprietary operating system—yep, another kiss of death: the proprietary operating system. Little applets are available under that operating system that are supposed to match the needs of the executive. Some may actually be useful. . .if the executive ever finds them.

The screen is dim, but a better one is promised on the production models. And the machine is expensive—but hey, for this class of upper-level "knowledge workers," price just doesn't matter, huh? Anyone who has the time (and the inclination) to roll around on the office carpet with his PC probably doesn't worry much what it cost.

Pen-based computing will explode this year and next. Lots of people are going to find pen PCs very much to their liking. Lots of attractive pen-based applications—most, for vertical markets, but some for wider use—are being created right now.

Sadly, Momenta won't be riding the crest of that wave, but will, I think, be swept under it.

In fairness to Momenta, I should say that I am almost alone in concluding that the machine is destined to fail. Other analysts and commentators are held in thrall by it, and they may be right.

But I think we're about to see a costly but vivid reminder of the importance of focus in this business: Spot a need, then fill it. Great products don't need people rolling around on the floor. ■

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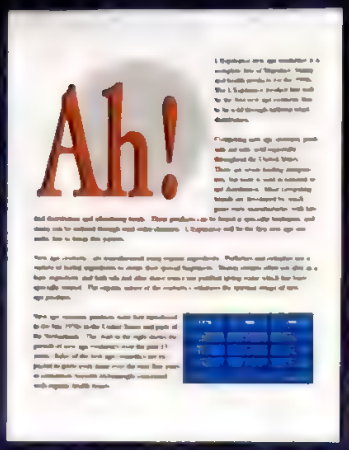

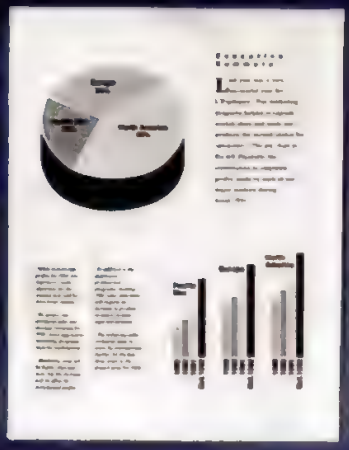

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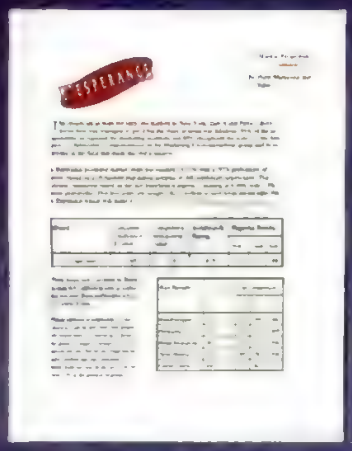

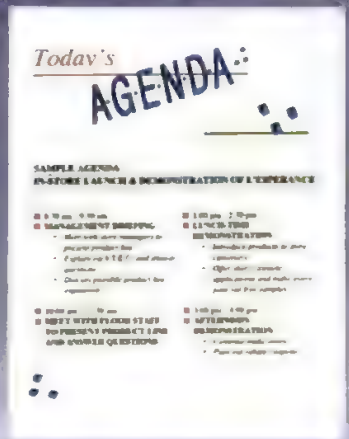

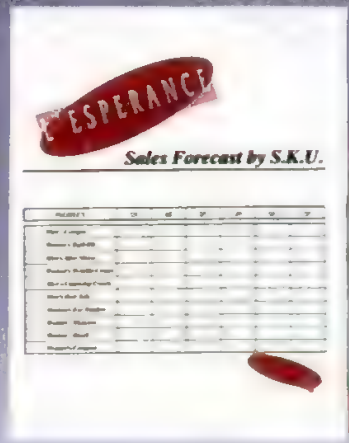

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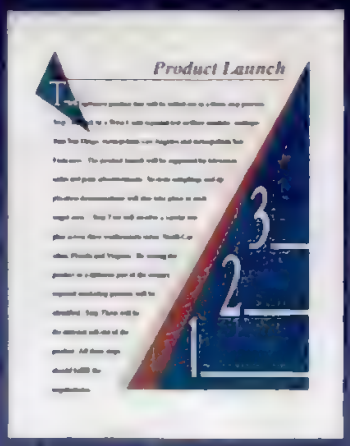

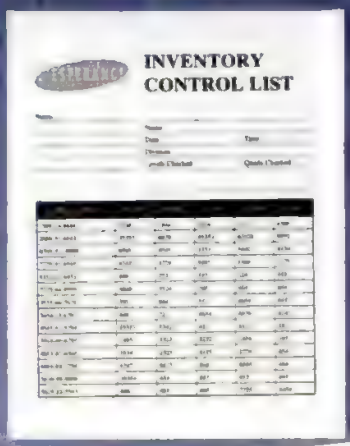

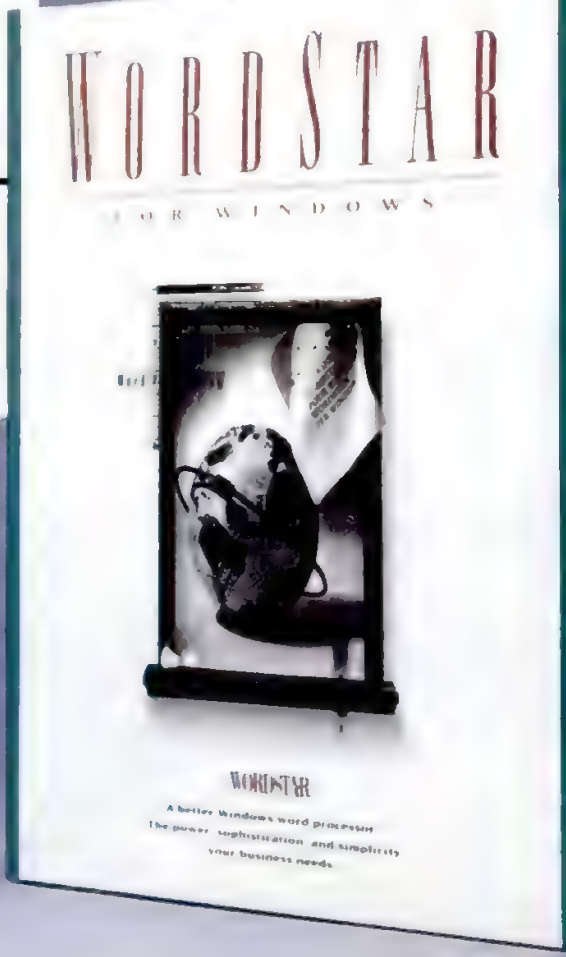

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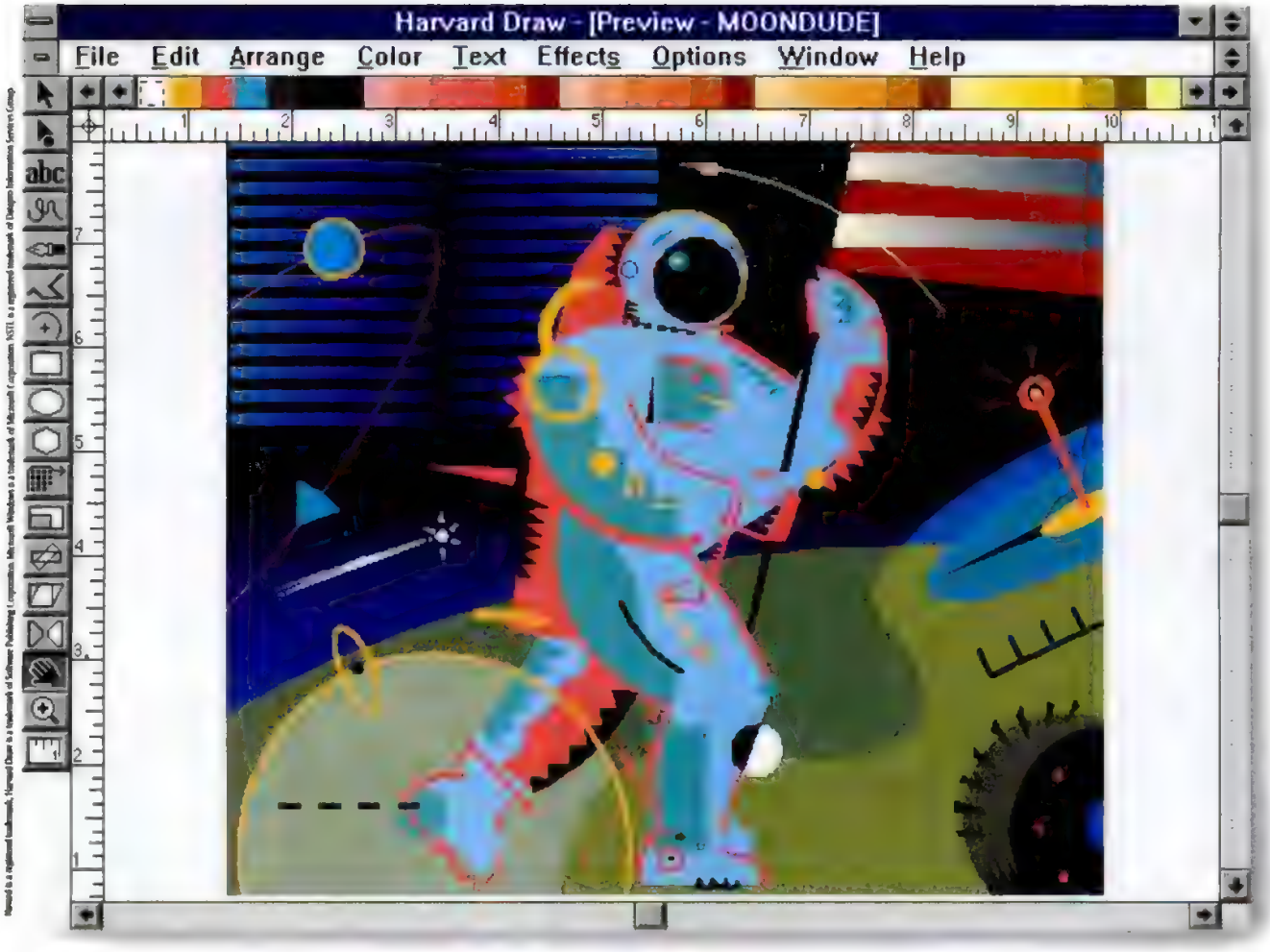

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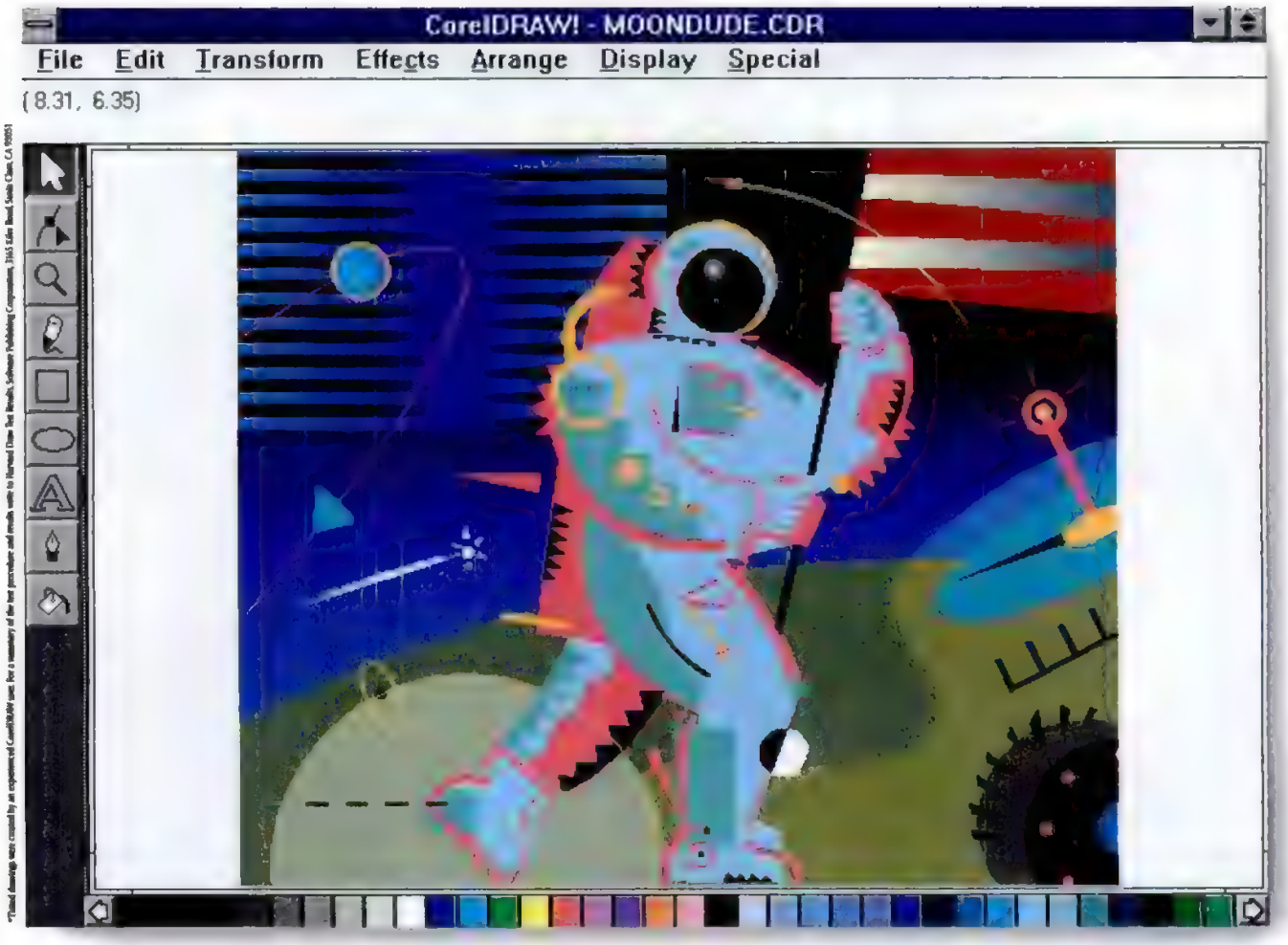

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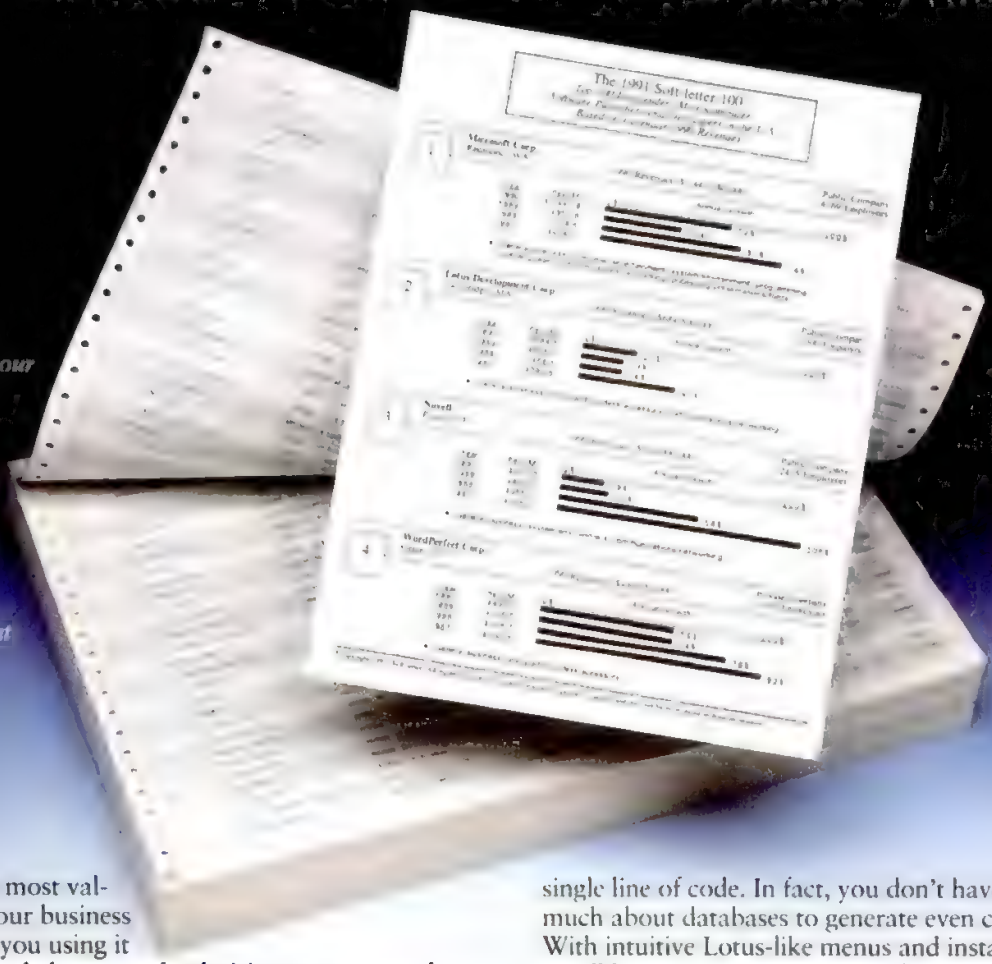

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CIRCLE 315 ON READER SERVICE CARD

William F. Zachmann

Does the Best Product Always Win?

The battle between hype and excellence in the marketplace.

Are the best hardware and software products also the most successful products? Do the best products sell better than less capable competitors? Or do mediocre products from more prestigious vendors often win because of superior marketing?

The conventional wisdom seems to be that hype wins. One often hears claims that a mediocre product has won out over "better" competitors. Examples are not hard to find. The introduction of the original IBM PC is one of the most frequently cited cases. It has become almost a truism to say that the IBM PC was successful not because it was better than its competitors but because it had IBM's prestige and marketing behind it.

Another frequent claim is that better products often fail because the vendor is not sufficiently prestigious, because marketing is mediocre, or because buyers are simply too obtuse to properly appreciate their superiority. Recent examples cited by some analysts include Steve Jobs' NeXT system and GeoWorks' *Ensemble*. Both have been touted as superior to their competitors by some experts, but neither has been very successful in the marketplace.

Are buyers really too dumb to recognize and buy a better product when they see one? Not at all. The evidence is clear that mediocre products rarely make it simply because of a vendor's prestige or superior marketing, and there are plenty of examples of truly superior products succeeding despite indifferent marketing. Buyers are smarter than the conventional wisdom would have it.

Some industry observers don't understand what really makes a product better. They mistake "gee-whiz" technology for genuine utility. The big artificial intelligence bust of the late 1980s is a clear example. The market was smarter than the pontificators and recognized what they didn't: AI really didn't do much that normal people needed or wanted.

The key to the success of the original IBM PC was not gee-whiz technology. Its use of the simple technological advance from an 8-bit to a 16-bit processor built with standard parts delivered enhanced practical value to users. The IBM PC may have been technologically pedestrian, but it was the first system that could run a wide range of software that took advantage of the larger memory address space a 16-bit microprocessor could support. It really was a superior product for its day.

However, IBM's PS/2 line was not. Despite enormous marketing hype and huge ad budgets, the original PS/2 models were mediocre performers and overpriced. If marketing clout or vendor prestige alone were enough to do the job, IBM would have gained market share. Instead, IBM dramatically lost market share after the 1987 introduction of the PS/2 line.

Truly excellent products often succeed despite ineffective marketing. Borland's early successes with *Turbo Pascal* and *Sidekick* were primarily the result of word-of-mouth among smart users and a few influential columnists, including my colleague John C. Dvorak.

Brief, the superb programmer's text editor, is another example of a product that succeeded despite minimal initial marketing or advertising. *DESQView* and the *QEMM* memory manager by Quarterdeck are further examples.

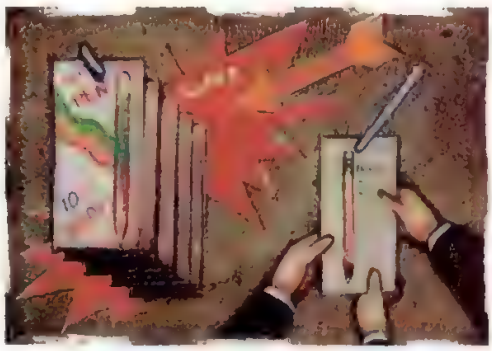

ILLUSTRATION: JOHN LABBE

In its early days, Quarterdeck was notorious for inept marketing. Yet its products succeeded because they did something useful for users.

Of course, good marketing matters. Good products can do even better with good marketing. However, good marketing can seldom make a mediocre product more successful than a significantly better one. Most important, excellent products are likely to succeed eventually, despite mediocre marketing. It just takes them a little longer. ■

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PC MAGAZINE EDITORS' CHOICE November 26, 1991 Okidata OL830

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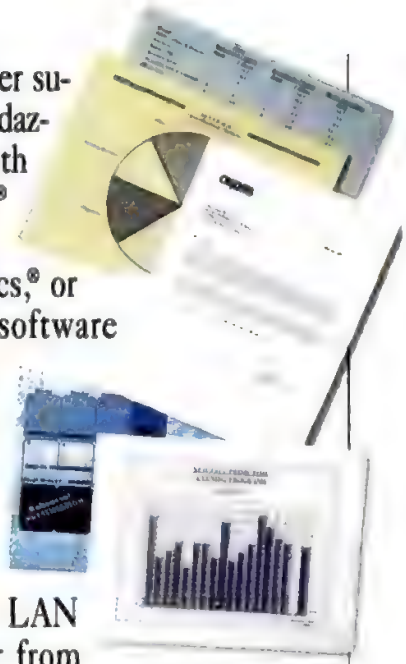

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CIRCLE 235 ON READER SERVICE CARD

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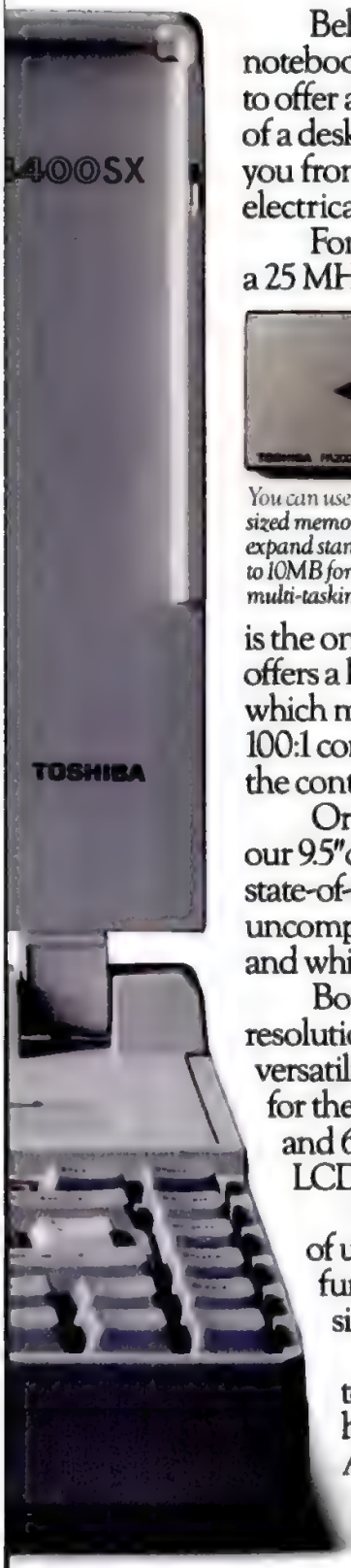
FUL 486SX. GOING.



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The T4400SX is the only notebook computer that offers a high-speed Gas Plasma screen, which means no mouse blur. And its 100:1 contrast ratio delivers seven times the contrast of a typical LCD display.

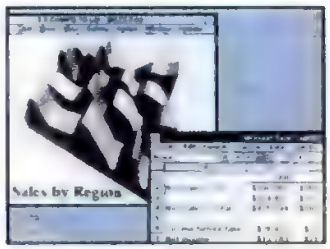
Or if you prefer, you can choose our 9.5" diagonal LCD display, the most state-of-the-art LCD available, with uncompromising clarity from the black and white ultra thin screen.

Both offer a 640 x 480 VGA high-resolution display as well as the graphic versatility of 16 gray scales for the gas plasma screen and 64 gray scales for the LCD screen.

For familiarity and ease of use, the T4400SX has a full-function keyboard with standard size keys and key spacing.

The Nickel Cadmium battery provides more than three hours of computing power. Our AutoResume feature allows you to shut down and start up precisely where you left off.

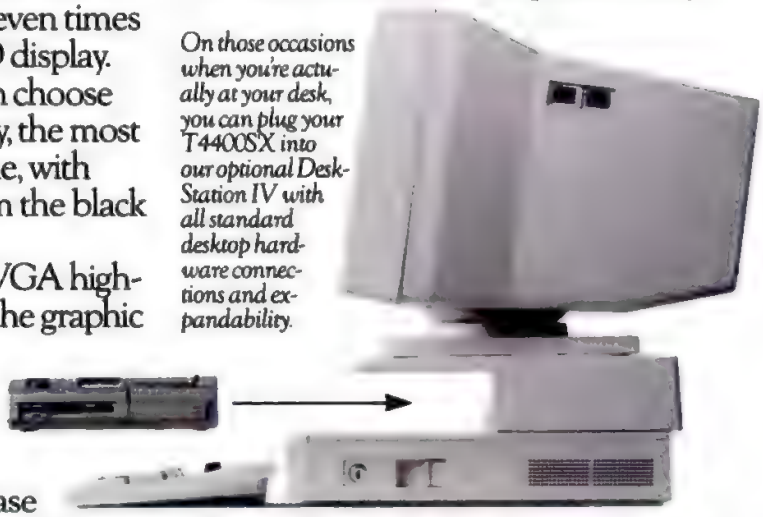
And for added expandability and connectivity, there are built-in parallel, serial, video, keypad/board, mouse and bus expansion ports. There's even a dedicated modem slot for an optional internal cellular-ready, 9600 bps fax or standard modem.



If you choose the 9.5" diagonal LCD display, you get the versatility of 64 gray scales as well as high-resolution 640 x 480 VGA on the black and white ultra thin screen.

All that in an ultra-strong 11.7" W x 8.3" D x 2.2" H carbon fiber-reinforced case weighing only 7.25 lbs that fits into half a briefcase.

If you'd like to know more about the T4400SX notebook computer, or any of our full line of Toshiba portables, call us at 1-800-457-7777.



On those occasions when you're actually at your desk, you can plug your T4400SX into our optional Desk-Station IV with all standard desktop hardware connections and expandability.

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INFO WORLD

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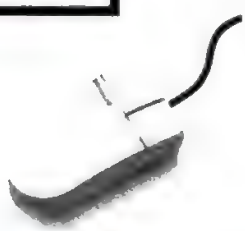
	(InfoWorld weightings)	Harvard Project Manager Version 3.02	Instaplan 5000 Version 2.0	Microsoft Project for Windows Version 1.0	Project Scheduler 5 Version 1.0	Superproject Expert Version 1.1	Time Line Version 4.0
Price		[illegible]	$548	[illegible]	[illegible]	[illegible]	[illegible]
Performance							
Tracking and flexibility	(175)	Satisfactory	Good	Very Good	Excellent	Very Good	Very Good
Rescheduling/resource leveling	(100)	Satisfactory	Satisfactory	Good	Excellent	Very Good	Very Good
Speed	(75)	Satisfactory	Very Good	Excellent	Very Good	Very Good	Satisfactory
Reporting	(100)	Good	Good	Good	Very Good	Very Good	Very Good
Documentation	(75)	Very Good	Good	Very Good	Very Good	Good	Very Good
Ease of learning	(100)	Very Good	Very Good	Very Good	Very Good	Good	Very Good
Ease of use	(125)	Good	Good	Very Good	Excellent	Good	Good
Error handling	(75)	Good	Good	Satisfactory	Very Good	Good	Very Good
Support							
Support policies	(50)	Good	Good	Very Good	Good	Good	Very Good
Technical support	(50)	Very Good	Very Good	Satisfactory	Excellent	Satisfactory	Very Good
Value	(75)	Satisfactory	Good	Very Good	Excellent	Very Good	Very Good
Final scores		**6.0**	**6.4**	**7.1**	**8.7**	**6.8**	**7.1**

Source: *InfoWorld*, November 26, 1990



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COVER STORY

THE $2,000 NOTEBOOK

Everybody loves a bargain—especially smart PC buyers. PC Labs tests 15 notebook PCs selling for less than $2,000 each. These lightweight systems come complete with at least 2MB of RAM, a 40MB hard disk, and DOS.

PHOTOGRAPHY RICK BECKER

BY ALFRED POOR A year ago, some portable computers weighed as little as 7 pounds, some had 386SX processors, and others cost less than $2,000. But few combined any two of those factors in a single machine, and none offered all three.

Now we have a whole trunkful that are lightweight, powerful, and inexpensive. In this article, we review notebook computers that you can buy for less than $2,000 each. Only two notebooks broke that price barrier when we last reviewed this category: the Bitwise 386SX/16 Notebook and its identical twin, the Micro Telesis NBA386SX ("386SX Notebooks: Desktop Power, Notebook Size," August 1991). Now there are at least 15 systems that fit the sub-$2,000 category—and

IN THIS REVIEW:

Altec 386SX/20 NB
Blackship 386SX/20NB
Fora NBS-386S/20
Insight 386SX-20 Notebook
Intelec INT-NBSX20-40
Master Cascade Notebook Model 203
Maxtron 386SX-20 Note Book Model 303V
MicroStar NoteStar NP-902
MicroStar NoteStar NP-903
Micro Telesis Jetbook-386SX
National Micro Systems Flash NT386SX-20
New MMI CMO NB-320SX
Standard SX/20 Notebook
Tangent Model 320N Voyager SX
USA FlexNote 20

many more if you include older, heavier, or discontinued models. (One system, MicroStar's NoteStar NP-903, has a $2,190 price tag. Because it's available through the retail channel, however, you can most likely find it for less than $2,000.)

These companies don't skimp in their configurations, either. Given the market's strong interest in Microsoft Windows 3.0, we required that these machines be at least minimally equipped to handle that environment. Though Microsoft Corp. says you can run Windows on a system with only 1MB of memory, we asked that each PC in this review come equipped with at least 2MB.

REVIEW CRITERIA

Also on our list of requirements: at least 40MB of hard disk storage, a VGA display, and DOS 5.0 (though we accepted Version 4.01). Only one of the group uses an 80286 processor—an indication of how fast the SX chip has killed the 286 market; the others use 386SX CPUs. Of the 386SXs, only one machine is rated at 16 MHz; the remaining 13 have a 20-MHz chip.

The other details vary. While most of the review units came with just 2MB of memory, others had twice as much. And while most had a 40MB hard disk, a few had a 60MB unit. All include DOS, but some throw in extras, such as Windows, a mouse, application programs, a fax modem, and more. If you're a bargain hunter, you will find plenty to compare among these 15 machines.

It should be no surprise that these machines aren't the absolute latest word in portable technology—not at these prices. For example, Intel's 386SL chip incorporates many sophisticated power-saving features that help extend battery life. So far, only Zenith Data Systems has shipped a 386SL system, though others, such as Advanced Logic Research, Sharp Electronics Corp., and Epson America, promise to be shipping them by the time this article is in print. Advanced Micro Devices, too, has developed its own line of low-power 386-compatible chips for notebooks. You won't find either of these chips in this field; you get plain-vanilla 386SX CPUs.

Some of the big-name and higher-priced models use new technology for extending battery life. Nickel hydride batteries, for instance, have the potential to store more electricity per pound than nickel cadmium designs can, but you will find only the lower-cost nickel cadmium batteries in these computers. And though most of the notebooks in this group have some sort of a standby mode, none have a long-term sleep mode, which is best exemplified by the auto-resume feature offered by PCs from Toshiba America Information Systems.

By using last year's technology, these computers offer portable functionality at remarkably low prices. And it looks as if we will have some time to wait for the newer technology to be available at prices even close to these. While the inexpensive models reviewed here may not be as sophisticated as newer designs, they are still able to get the job done.

Keep in mind that you can find even lower-priced battery-powered laptops capable of running Windows. There are

SYSTEM PERFORMANCE: A GUIDE TO THE GRAPHICS

PC LABS

BENCHMARK TESTS

The Bars
These charts show each product's scores on four tests relative to the best, worst, and average scores of previously tested products in the same processor class. We made an exception for MicroStar's NoteStar NP-902—a 286/12 unit, which we compared with the 386SX/16 notebooks.

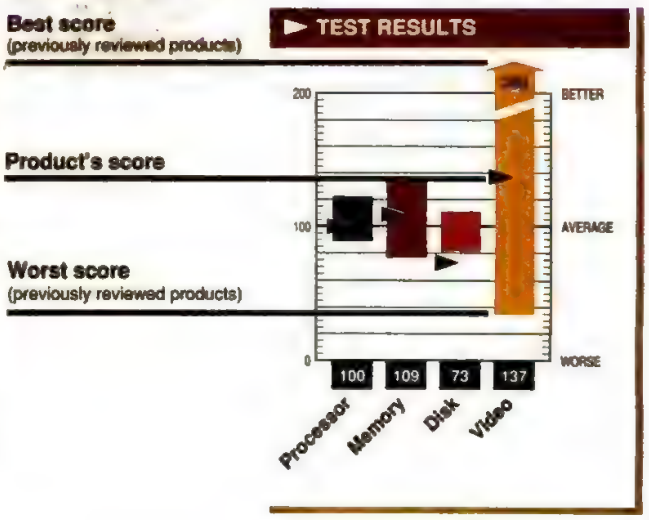
We created separate charts for 16-MHz and 20-MHz processors. Each colored bar represents the range of 16-MHz or 20-MHz test scores, from fastest to slowest. *The longer the bar, the wider the range.* If the best score is more than twice as fast as average, an upward-pointing arrow appears atop the colored bar.

A black arrow on each bar represents a system's **position** relative to the historical range. *The higher the arrow, the better the performance.* If a system performs more than twice as fast as average, the black arrow appears at the top of the bar, pointing upward.

The Boxes
A normalized score appears in the box below each colored bar. To derive this figure, we calculated the average score for all the portable 386SX systems of the same processor type that were previously reviewed in *PC Magazine* (March 13, 1990; October 16, 1990; March 12, 1991; and August 1991). We then divided this average by the score of each machine in turn and multiplied by 100.

Thus the average score is 100; a number greater than 200 indicates that a system performed the test in less than half the average time; a number smaller than 50 indicates that the system took more than twice as long to complete the test.

A table of **actual scores** accompanies the three-dimensional bar charts.



machines that are a generation or more behind even these. You may have to dig in some of the mail-order catalogs and bargain outlets if you want to find them, but they are definitely out there.

For example, the November 1991 catalog from Damark International (7101 Winnetka Ave. North, P.O. Box 29900, Minneapolis, MN 55429-0900; 800-729-9000) offered a Bondwell Industrial Co. laptop with a 286 processor, 40MB hard disk, 1.44MB floppy disk drive, and VGA backlit TST (triple supertwist) LCD screen with 1MB memory (upgradable to 5MB) for just under $1,020, including shipping. Similarly, Olden (1265 Broadway, New York, NY 10001; 212-725-1234) recently advertised an NEC UltraLite 286V with 1MB of RAM and a 20MB hard disk for $1,195. And the mail-order-house Megasource (2216 Commerce Pkwy., Virginia Beach, VA 23454; 800-473-9728) advertised the Leading Edge D/LT 386SX Plus—with a 386SX/16 CPU, 2MB of RAM, a 20MB hard disk, a 1.44MB floppy disk drive, a VGA display, DOS, and Windows—for $1,649 this past November.

Then there are the top names: Since our last review of notebooks, many of the best-known systems—the $2,738 Dell System 320N, the $3,995 IBM PS/2 Model L40 SX, and the $2,958 Toshiba T2000SX, to name a few—have had their prices slashed 25 percent or more.

These products and others like them don't show up in this review. The "first-tier" and "second-tier" products are still too high-priced. Many of the real bargains, meanwhile, weigh more than 8 pounds; some are underconfigured for our purposes, and more than a few are no longer available from their original manufacturers. The deals you see are frequently for older, discontinued products, so repair and support are always a concern. On the other hand, your programs will run on these machines, so if you don't mind the extra weight and are willing to take on some of the risk that comes with owning an orphan machine, a little bargain sleuthing can pay off in savings.

WHO SHOULD BUY ONE?

This leads us to the notebooks we cover in this review and raises one important question: What are they best suited for? Obviously, you can take these portable systems anywhere, and because they weigh so little, you won't have to think twice about taking your favorite computing tools with you to help get your work done.

Many people may even consider obtaining notebooks as their primary computers, though they may feel a bit restricted with only 40MB of storage. (Programs such as InfoChip's *Expanz!* or Stac Electronics' *Stacker* can effectively double that capacity.) You can configure these PCs, which cost $2,000 and less for a complete system, for office use at a relatively low cost; you can get the functional equivalent of a desktop system by adding a full-size keyboard and a VGA color monitor. You won't hurt yourself when you decide to take your computer home or on a business trip, and you can run the system on batteries when you're away from an AC outlet.

Some people will also want to get an extra monitor and keyboard for a second work location, perhaps at the office or at home. (Keep in mind, however, that if you

PC MAGAZINE EDITORS' CHOICE

■ USA FlexNote 20

With the USA FlexNote 20, two grand doesn't buy a name-brand notebook. But it certainly provides you with reasonable on-the-road computing—if you're willing to compromise.

The 15 notebooks in this review vary greatly in terms of the features *PC Magazine* considers essential for a portable computer: namely, a weight of less than 7 pounds, a battery life of at least 2 hours, internal modem capability, and a separate inverted-T cursor-key layout that lets you avoid the function keys. Then there are the niceties the company throws in while holding the price at less than $2,000: a 60MB hard disk, a Super VGA external display capability, software such as Microsoft Windows 3.0, and an error-correcting modem.

Of the 15 systems we reviewed, USA Flex gives you the most goodies for a sub-$2,000 price. The FlexNote packs an extra wallop, with a 60MB hard disk, Windows, *PFS:WindowsWorks*, and diagnostic software. The case appears rugged, and an internal modem with send-fax capability is a valuable extra. The FlexNote's biggest drawbacks are its Compaq-like L-shape cursor-key positioning and its 1 hour 47 minutes of battery life; USA Flex compensates by throwing in a spare battery for the same $1,995.

The $1,975 Fora NBS-386S/20 has a fine feature set as well. This system and its twin, the Standard SX/20 Notebook, are worthy of an honorable mention. Each of these two systems covers all the bases, even if neither one has a single strength. A built-in modem, for instance, offers both data and fax transmissions but lacks MNP 5 or V.42bis error correction. The keyboard has the touch typist's inverted-T cursor-key layout, though the keycaps themselves are somewhat flimsy. Battery life hovers around the 2-hour mark on both systems (with the Fora unit's battery eking out 9 minutes more than the Standard notebook's nickel cadmium battery).

If battery life and versatility are what you want, you might also look at MicroStar's NoteStar NP-903. (Spend the extra $300 and get this 16-MHz 386SX instead of the underpowered, 286-based NoteStar NP-902.) The NP-903's clever design makes this notebook convenient for desktop use, thanks to peripherals such as a SCSI adapter, ARCnet and Ethernet modules, and an external modem. This system's most notable advantage is a true 3-hour battery life, using two batteries. Don't look for light weight, however. The box, with both batteries installed, weighs 8 pounds.

The best feature of any of these systems is the price. When Compaq and Toshiba are selling their notebooks for $3,000 or more, it's comforting to know that you can still take one with you—and pocket the change.

do not intend to do any work in a third location or while in transit, you can save money by buying a desktop system for each location and carrying floppy disks back and forth; fully configured 386SX systems now sell for less than $1,500.)

The real payoff comes when you need to have a computer accessible at places other than your office or home. If you need to use your computer at customer or client sites, or if you travel and want to work on a train or plane, then the economics start to favor putting the bulk of your budget into a notebook PC rather than one or more desktop units.

MAKING YOUR SELECTION

If you have an unlimited budget, you can probably find exactly what you want. When you are trolling the lower reaches of the price scale, however, you might need to make compromises. The hardest part of the buying decision is knowing which features are must-haves and which you can do without: Do you need a bright screen? A familiar keyboard? Great battery life? Generous expansion capability?

You can't live without the LCD screen and the built-in keyboard, since you are likely to leave your monitor and full-size keyboard behind when you travel. Pay most attention to these two features. The screens in this group of notebooks are generally equivalent in terms of image quality, though a few are noteworthy, for better or worse—some brighter than others, some with a sharper, less streaky image. Some systems with dimmer screens scored better on PC Magazine Labs' Battery Rundown test, so you may have to decide which is more important—a great display or longer battery life.

You will also find a wide variety of keyboard styles, as manufacturers have sought different ways to squeeze the functionality of a 19.5-inch-wide 101-key keyboard into an 11-inch-wide space. Choosing one solution over another is mostly a matter of personal preference.

One detail to look at is how the cursor keys are arranged. Many designs save space by doubling up the four cursor keys with Home, End, PgUp, and PgDn: An extra function key (Fn) activates the second set of movements. Some people find this setup more difficult to use than one that has eight separate keys (as Toshiba portables do), while other users adapt easily to the change. The programs you use on a regular basis may have an impact on how quickly you adjust to this type of

PRICE/PERFORMANCE INDEX: INEXPENSIVE NOTEBOOKS

The Micro Telesis Jetbook-386SX, among the least expensive systems in this review, also has one of the highest performance/features scores.

In terms of sheer bang for the buck, the Micro Telesis Jetbook-386SX wins. At $1,824 for a system with a modem, this notebook beats every other price in this roundup. It even comes with some advanced features—an error-correcting 2,400-bps modem, for instance—and a somewhat extended warranty as well. The Jetbook's fast video also enhanced its score.

Other above-average performers include the Fora NBS 386S/20 and its twin, the Standard SX/20 Notebook (both manufactured by Sampo), and the USA FlexNote 20. Each of these three notebooks is a fine all-around performer (though the battery life is slightly deficient) and comes with value-enhancing extras. The FlexNote, for instance, comes with a free copy of *PFS:WindowsWorks* and other software, and an extra battery; it is also available with a high-speed fax/data modem. The Fora and Standard units have some extra software bundled free.

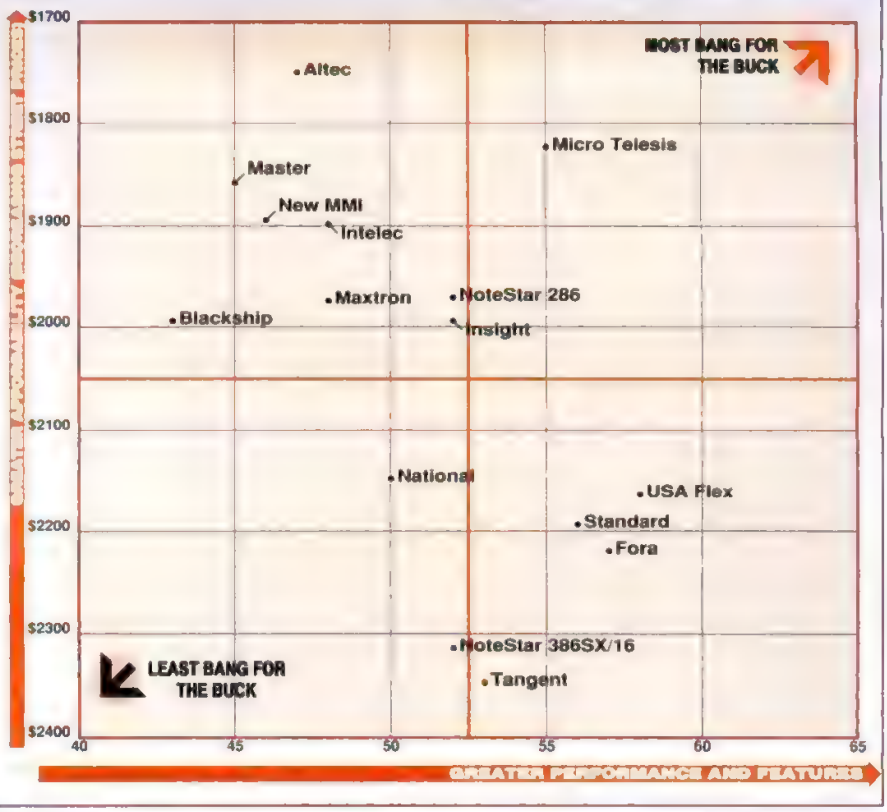
DETERMINING BANG FOR THE BUCK

The chart below rates the 15 reviewed 286, 386SX/16, and 386SX/20 notebook computers on more than 20 features and performance aspects and plots each rating against the computer's selling price. The *x*-axis measures increasing performance. The *y*-axis measures increasing affordability (lower price).

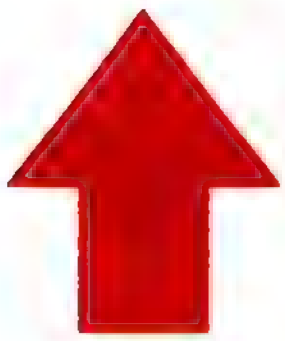
The scores on four PC Magazine Labs benchmark tests (processor, memory, disk, and video) account for almost half a machine's value on the performance index. Three measures of portability account for another third: weight (system, battery, and transformer), size, and battery life. Another 15 percent reflects the amount of disk and system memory. The remainder of the score is a measure of features that make a laptop more versatile and powerful: screen size, modem, Super VGA external video capability, extra cursor keys, I/O ports, power conservation, free carrying case, free software, mouse or other pointing device, and extended warranty or free on-site service. More sophisticated features also earned extra credit: For instance, an internal modem with error correction, V.42bis data compression, or fax capabilities was rated more valuable than a vanilla 2,400-bps modem.

The system price includes the price of the most useful modem. Laptops available through dealers were discounted 15 percent. Mail-order systems were not discounted.

Because the price/performance index is subjective, we've posted the worksheet used to create the chart on PC MagNet's editorial forum; look for 02BANG WK1. These numbers are not directly comparable with the price/performance numbers in our desktop PC reviews.



NEC introduces a 486 series that has a built-in survival instinct.



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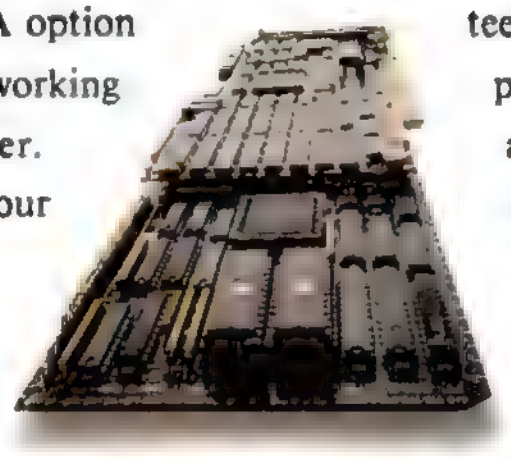

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Desktops:	NEC PowerMate® Express Desktops	COMPAQ Deskpro 33 Series	AST Premium II Series	Advantage
Towers:	PowerMate Express Towers	Systempro/LT Series	Premium III 486 Series	Advantage
1. # SIMM sockets standard	16	4	4	NEC
	16	4	4	NEC
2. Maximum RAM capacity	64	64	80	AST
	112	64	80	NEC
3. Internal hard-drive storage capacity	2.7GB	1GB	420MB	NEC
	4GB	4GB	2.4GB	Tie
4. Power supply	285W	240W	167W	NEC
	300W	315W	300W	NEC
5. Internal fans	1	1	1	NEC
	4	2	2	NEC
6. Snap-in drive rails	Yes	No	No	NEC
	Yes	No	No	NEC

Data based on manufacturer supplied specifications

For more information, call 1-800 NEC-INFO (in Canada, 1-800-343-4418), or NEC FastFacts at 1-800-366-0476, #XPRESS (977377), for immediate literature.

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layout. The Home and End keys, for instance, are important keys for Windows, so if this is your environment, you may want separate keys.

An added complication is how the cursor keys are arranged: Some use an inverted-T cursor-key layout, while others are wrapped around the lower-right corner of the keyboard in a shape that more closely resembles a reclining L.

Some designs double up F11 and F12 on the F1 and F2 keys, which is rarely a problem because few programs use F11 and F12. Other notebooks have half- or three-quarter-size function, Del, Ins, or Esc keys. The small size means the keys are closer together, and touch-typists may find it difficult to reach the right ones. Other keys are often placed in unusual locations or given smaller key caps, including the Enter, Backslash, and Backspace keys. Test the keyboard thoroughly before you make your choice.

BATTERY LIFE MAY VARY

In this group, only MicroStar Computers' NoteStar NP-902 and NP-903 lasted 3 hours on a single charge, and both used dual-battery components that weighed nearly 2 pounds. While these times could be considered a worst-case scenario, since we run the systems at full screen brightness and with all power-saving features disabled, remember that many large programs will not permit much power saving anyway. If Windows frequently swaps to the hard disk, the hard disk shutdown feature may not save you much power. If you need more battery time, be sure to see how easily you can swap out a battery pack. Also watch for models that allow you to load two batteries at once.

Expandability varies with these systems, too. You won't find ISA expansion slots in these systems, but you may find different I/O port and expansion chassis options. You may want a place to plug in a mouse, for instance: Is there a mouse port, or must you use the serial port? If you have to take the serial-port route, is there a second one available for a pocket modem, or alternatively, does the system come with an internal modem? (Only about half of the systems in this review have the latter feature.) And if you need to tap into a network in your office or you have a scanner or other equipment that requires an expansion card, can you get an expansion unit or docking station?

Other factors differentiate these machines, but don't be dazzled by loads of features. A bundled copy of Windows and a mouse are convenient, but they are also inexpensive to purchase separately. The same can be said for other software items, such as communications programs or diagnostics. Paying for extra software to round out your purchase is only valuable if you end up with a notebook that better suits your needs.

Some features offer clear advantages if you have matching needs. For example, most of the notebooks in this group have an external VGA port for an external monitor. But only some have the extra ability to generate a Super VGA signal (800-by-600 resolution) through this port, and only the Maxtron 386SX-20 Note Book Model 303V lets you view your application simultaneously on the LCD screen and a monitor. If you use an external monitor (for sales presentations, as an example), this is an advantage. If you are going to use only the LCD panel, the feature offers no advantage at all.

The first step, therefore, is to decide your notebook's mission. Is it to be the versatile, go-anywhere replacement of a desktop system, or is it going to be a once-in-a-while travel tool? Will you use it as it is, or will you be adding a monitor, keyboard, mouse, and modem?

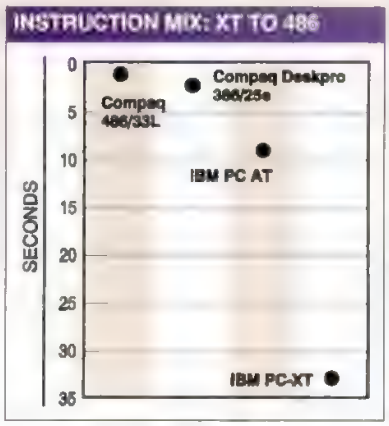
While many of these 15 notebooks represent some excellent values, they are not necessarily for everybody and every need. If you have a use that matches the capabilities of one of these machines and will not be unduly hampered by the compromises it embodies, then go for it. With the 7-pound equivalent of a desktop system stashed in your attache case, you will be ready to take Windows around the world.

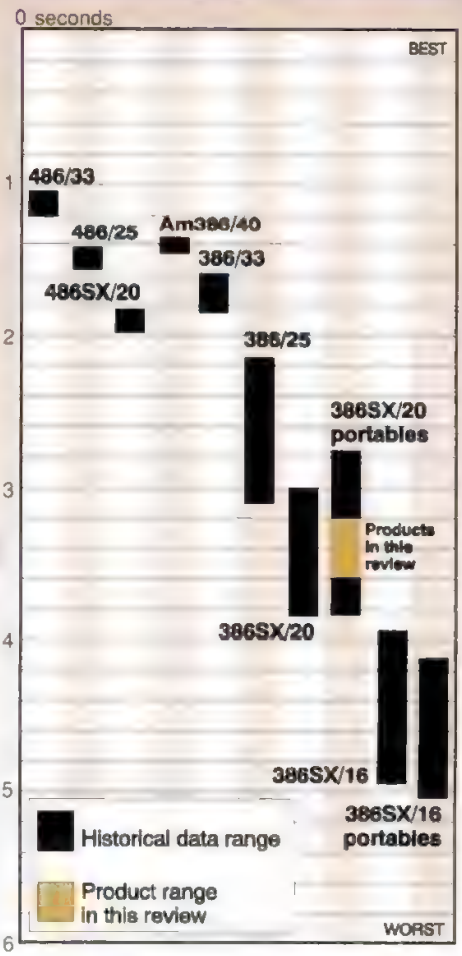
INEXPENSIVE NOTEBOOKS: JUST OFF THE MARK

PC LABS

In terms of pure processor performance, these 15 inexpensive notebooks buck the usual "faster and better" trend by turning in slightly slower-than-average scores.

The large chart, right, shows the range of Instruction Mix benchmark test scores, from fastest to slowest, for PCs tested by PC Magazine Labs over the past two years. The chart below shows the average Instruction Mix scores for the Compaq 486/33L, the Compaq Deskpro 386/25e, the 4.77-MHz IBM PC AT, and the 6-MHz IBM PC-XT. (These figures have a 0.05-second margin of error.)





ALTEC TECHNOLOGY CORP.

Altec 386SX/20 NB

NEW MMI CORP.

CMO NB-320SX

BY EDWARD PERRATORE Altec Technology Corp. and New MMI Corp. market two of this roundup's four virtually identical machines, which are made by Taiwan-based Chaplet Systems (Blackship Computer Systems and Intelec Corp. are the other two companies). It's a strategy that more and more companies are adopting to round out their product lines: ordering a basic system from a manufacturer like Chaplet but specifying the mix of components and peripherals. For their 386SX/20 notebook, for example, Altec and New MMI ordered a screen from Sharp. The Blackship and Intelec versions, which use a screen from Epson, are treated in another review.

Altec, a mail-order company just starting to distribute through dealers, has the best price of the four. For the *PC Magazine* configuration (2MB of RAM, a 40MB hard disk, utilities including a memory manager, DOS 5.0, a nickel cadmium battery, an AC/DC adapter, and a carrying case), the Altec 386SX/20 NB costs $1,795. Altec even includes Microsoft Windows 3.0 in the price. New MMI, a mail-order reseller, sells its CMO NB-320SX in the same configuration, minus Windows, for $1,895. (Blackship sells its version for $1,995, and Intelec for $1,899.)

Standard for these two systems is a VLSI chip set, an AMI BIOS, a 19-millisecond Conner hard disk, a Cirrus 8-bit VGA subsystem, a Sharp LCD screen, and an 80387SX coprocessor slot beneath the user-removable keyboard.

You can easily increase the amount of RAM to 6MB by adding proprietary 1MB, 2MB, or 4MB SIP modules that cost $70 per megabyte from Altec or $149 per megabyte from New MMI (quantity discounts apply). Upgrading to the full 8MB, however, is tricky. If you haven't requested the full complement of RAM at purchase, you must return the system to let the vendor replace the 2MB module, initially soldered in, with a 4MB module. Then either you or the vendor can plug in the other 4MB module.

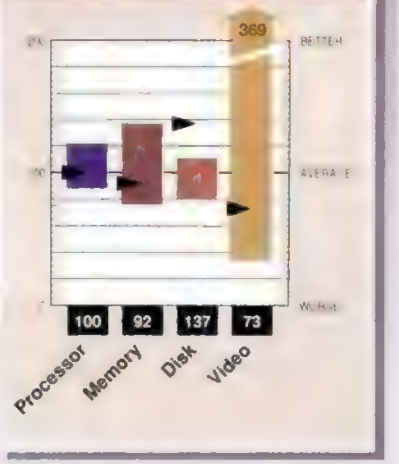
Construction is sturdy, with no play in the door covering the I/O ports. The LCD screen, though small at about 6.5 by 5 usable inches, offers good contrast with its 32 gray scales, even when the unit is running Windows applications; 8-bit video yielded a slower benchmark test result than 16-bit, though. Below the screen, on the case itself, two sliding brightness and contrast controls command a good range of display quality. Ports for an external keyboard and display run along the edges. In addition to the internal 1.44MB floppy disk drive that comes with the system, you can run an external floppy disk drive from the parallel port.

The keyboard of the units' compact case has the common Fn key aligned horizontally with the Ctrl and Alt keys. This makes it easier to combine Ctrl or Alt

Altec 386SX/20 NB

Battery Life: 2 hours 6 minutes.

TEST RESULTS



In Short: Good components—including a VLSI chip set, an AMI BIOS, a 32-bit Sharp VGA screen, and a 19-millisecond Conner hard disk—characterize the 6.5-pound Altec 386SX/20 NB. Microsoft Windows 3.0 makes this system even more of a bargain. Unfortunately, there is just one serial port and no space for an internal modem. Lack of efficient power management and an arduous route to full 8MB RAM expansion also dent the product's marketability.

386SX NOTEBOOKS: RECENT REVIEWS

Model	Price of standard configuration at review time	80386 Instruction Mix test score (seconds)	*PC Magazine* review (issue date and page)
			AUGUST 1991
ALR Venture/16	$2,795	4.18 (16 MHz)	112
AST Premium Exec 386SX/20	$2,995	3.44 (20 MHz)	125
Automated Computer Technology ACT Tempo 386SX	$2,845	4.17 (16 MHz)	128
Bitwise 386SX 16 Notebook	$1,995	4.23 (16 MHz)	136
Commax Notebook 386SX	$2,994	4.17 (16 MHz)	112
Compaq LTE 386s 20 Model 30	$4,399	3.09 (20 MHz)	143
CompuAdd CompanionSX	$2,999	3.78 (20 MHz)	144
Dataworld NB 320SX	$2,650	3.75 (20 MHz)	156
Dell System 320N	$3,548	3.53 (20 MHz)	163
Epson NB3s	$4,298	4.10 (16 MHz)	170
Everex Tempo LX	$3,299	4.18 (16 MHz)	128
IBM PS/2 L40 SX	$6,654	3.59 (20 MHz)	176
Leading Technology PC Partner XL	$2,495	3.25 (20 MHz)	184
Micro Express NB5620	$2,224	3.16 (20 MHz)	198
Micro Telesis NBA386SX	$1,699	4.11 (16 MHz)	136
Modern Computer Walkom NP-903	$3,500	4.17 (16 MHz)	203
NMS 80386SX 16 Notebook	$1,874	4.23 (16 MHz)	136
Northgate SlimLite	$3,299	3.30 (20 MHz)	208
Samsung NoteMaster 386S/16	$3,698	4.24 (16 MHz)	214
Sanyo MBC-18NB	$4,274	4.17 (16 MHz)	128
Tandon 386SX-20	$3,495	3.27 (20 MHz)	156
Tangent 320N	$2,183	3.16 (20 MHz)	198
TI Travelmate 3000	$4,199	3.79 (20 MHz)	144
Toshiba T2000SX	$4,999	4.56 (16 MHz)	218
Twinhead Supernote 386SX	$3,495	4.76 (16 MHz)	223
Veridata Execulite 386S	$4,185	3.34 (20 MHz)	228
Zeos Notebook 386	$3,014	4.16 (16 MHz)	128

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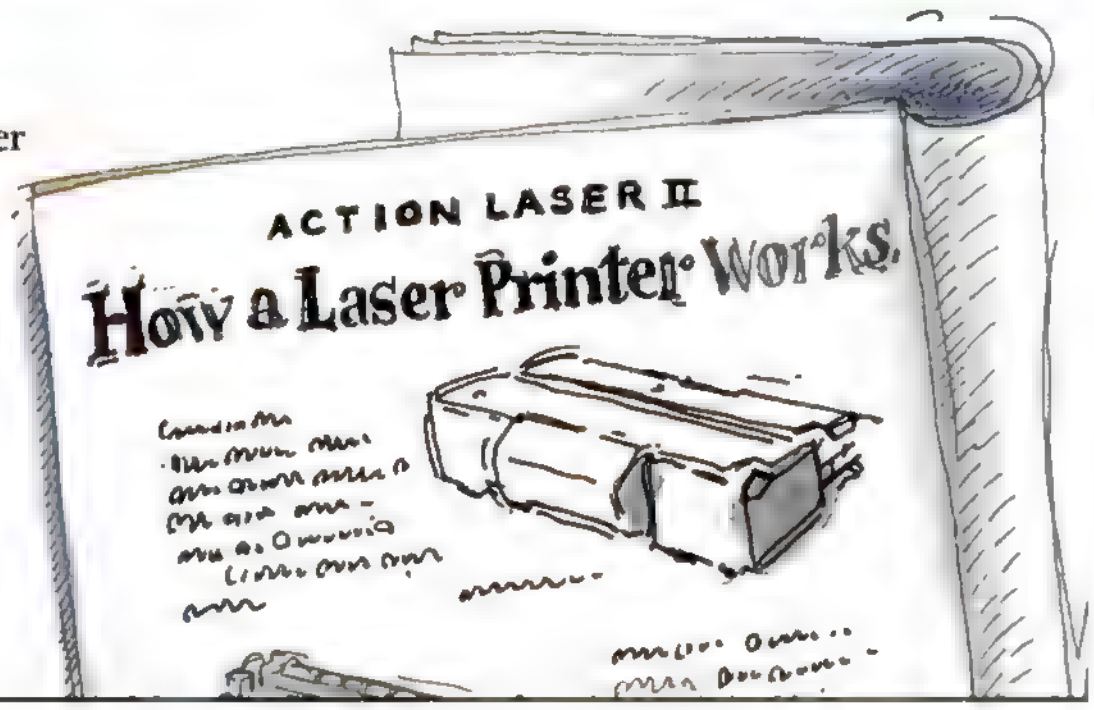

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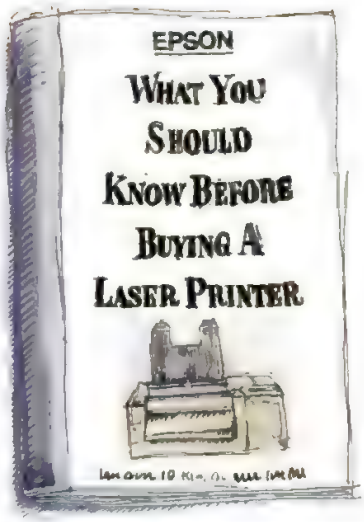

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Altec 386SX/20 NB
Altec Technology Corp., 18555 E. Gale Ave., City of Industry, CA 91748; 800-255-9971, 818-912-8688.
List Price: $1,750.
Tested Configuration: 2MB RAM, 40MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.0, AC power adapter, carrying case.
Options: 60MB unit, $80. 1MB RAM upgrade, $70; 4MB RAM upgrade, $280; 80387SX coprocessor, $175; expansion chassis, $320; extra battery, $99; external battery charger, $99; 2,400-bps modem with 9,600-bps send/receive fax and MNP 5 data compression, $215.

CIRCLE 421 ON READER SERVICE CARD

with other keys that require you to press Fn, such as Home, End, PgUp, and PgDn. What may take some getting used to is the 0.65-inch center-to-center key spacing among the function keys and a few others (0.75 inches is the norm). Cursor keys are arranged along the lower-right corner in a backward L shape.

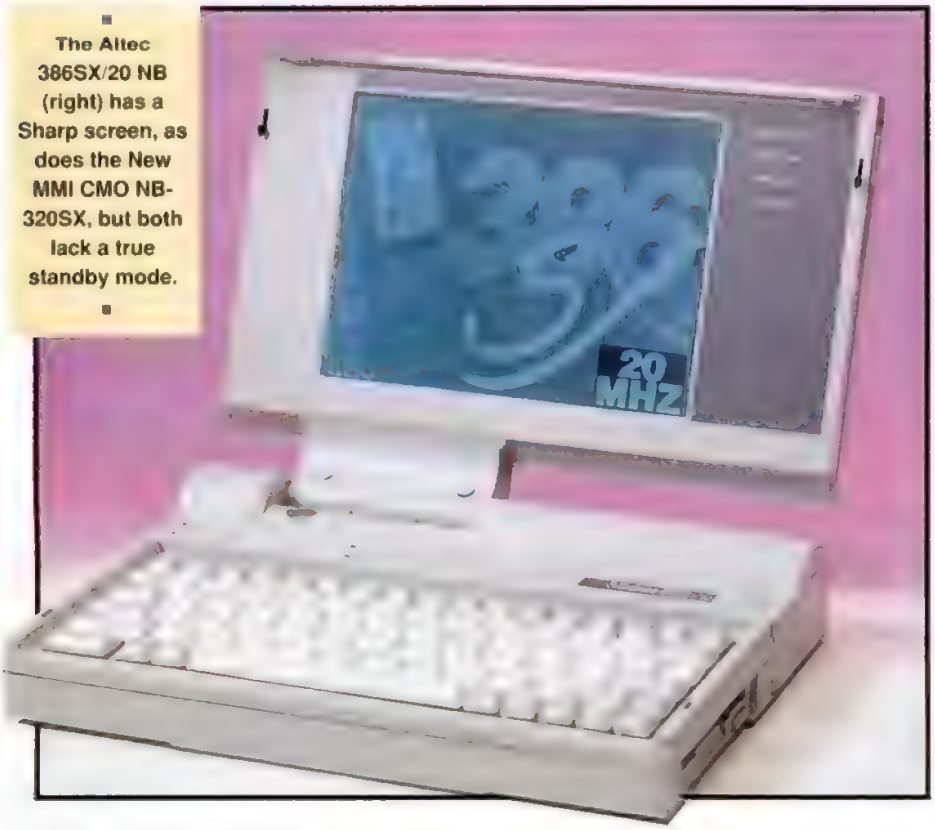
Carrying either the Altec or the New MMI around is relatively easy. Alone, the unit weighs 6.5 pounds, and with AC/DC adapter, battery, and case, the weight comes to 10.5 pounds. Things get tougher, however, when you want to add certain peripherals. Both systems have one parallel and one serial port, plus a 100-pin port for an expansion unit ($320 from Altec, $369 from New MMI). This unit holds two full-length 16-bit boards and one 5.25-inch drive bay that you can use for a floppy disk drive or a tape backup unit. True, the expansion unit is an option, but if you need both a modem and a mouse, the lack of a mouse port will force you either to hook and unhook these devices from the serial port as needed or to lug around the expansion unit.

Both companies offer pocket fax/modems that plug directly into the serial port. Altec offers one $215 model that combines a 2,400-bps modem (MNP 5 error correction) with a 9,600-bps send/receive fax. New MMI offers two: The first, for $119, is a 2,400-bps modem with no error correction and 4,800-bps send-only fax; the second, for $199, has the same modem capabilities but gives you 9,600-bps send/receive fax capabilities.

Perhaps the biggest drawback to these systems is power management, though these two systems both provided better than 2-hour life from a single battery. Since they are sold without a third-party program such as *Battery Watch*, you have to keep track of battery power on your own when you're on the road. (Either check your watch frequently or wait for the 1-minute-left alarm, which you will miss if you go for coffee.) Otherwise you will be surprised when the alarm sounds and the power light flashes orange for about a minute before the system goes dead—barely enough time to close more than one file.

You won't find a true standby mode in this machine. Instead, you get a number of piecemeal solutions for power conservation. The display blanks automatically (even in Windows) after 80 seconds of inactivity, and you can use a hotkey sequence for manual blanking or a supplied utility program to change the period's length. Another utility will shut down the hard disk motor, and a third can step down the CPU speed to 6.67 MHz.

One potential negative is the hidden cost of an external battery charger. Priced at $99 from Altec or $125 from New MMI, you will need this option if you want to charge a battery in 4 hours. The

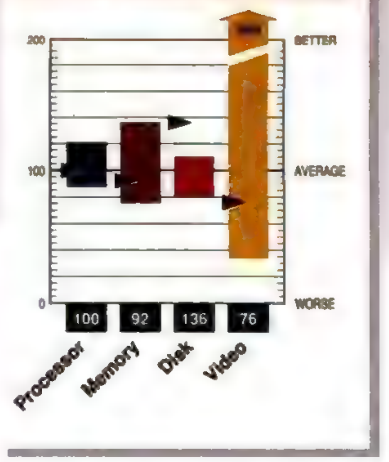


The Altec 386SX/20 NB (right) has a Sharp screen, as does the New MMI CMO NB-320SX, but both lack a true standby mode.

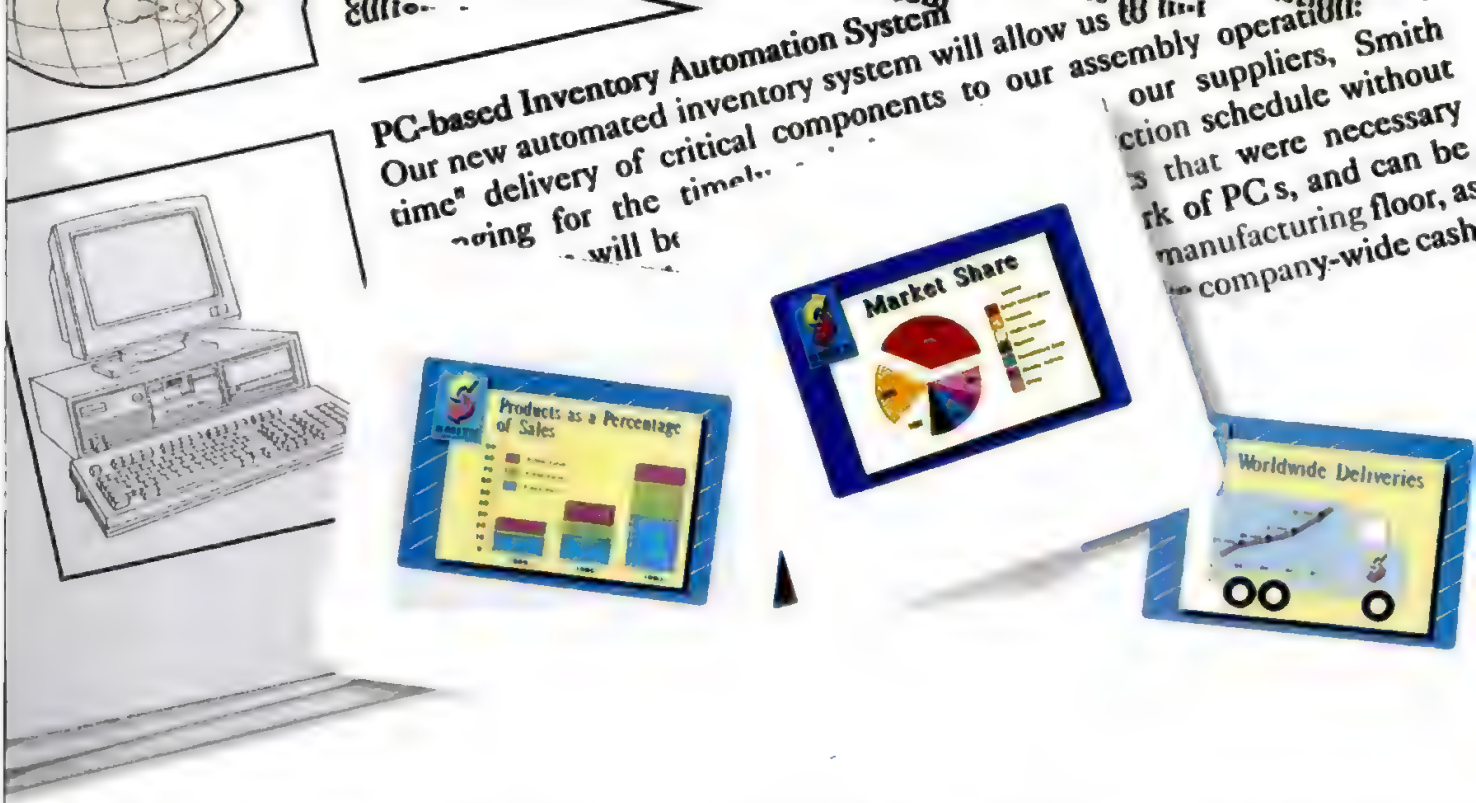
New MMI CMO NB-320SX

Battery Life: 2 hours 12 minutes.

TEST RESULTS



In Short: Higher-priced than the virtually identical Altec 386SX/20 NB in terms of system and add-on components (such as the coprocessor, RAM, and a modem), the CMO NB-320SX offers similar solid construction, a crisp VGA display, and good 6.5-pound weight. But there is no space for an internal modem, and an expansion unit costs a hefty $369. Another sacrifice for the price is the unit's too-late low-power warning, with no way to check the status.



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CMO NB-320SX
New MMI Corp., 2400 Reach Rd., Williamsport, PA 17701; 800-221-4283, 717-327-9575.
List Price: $1,895.
Tested Configuration: 2MB RAM, 40MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case.
Options: 1MB RAM upgrade, $149; 2MB RAM upgrade, $269; 4MB RAM upgrade, $399; external floppy disk drive, $219; 80387SX coprocessor, $140; numeric keypad, $69; expansion chassis, $369; extra battery, $85; external battery charger, $125; car battery adapter, $99; ArcNET or Ethernet adapter, $419; thick Ethernet adapter, $549; 2,400-bps modem with 4,800-bps send-only fax, $119; 2,400-bps modem with 9,600-bps send/receive fax, $199.

CIRCLE 544 ON READER SERVICE CARD

alternative is a 6-hour charge from the included AC/DC adapter.

Both Altec and New MMI offer a one-year warranty with a 30-day money-back guarantee. If you run into trouble during that 30-day period, Altec pays for all the shipping. After that (or through the entire year of New MMI's warranty), each company mirror-ships the repaired unit back.

You won't find cutting-edge innovation with these PCs. Both are solidly constructed machines that perform well, but the compromises taken in their design and flexibility are evident. While the Altec is the best-priced of these four Chaplet machines (and of the entire roundup), a second-generation, 25-MHz model is promised, with 4MB of RAM, a 60MB hard disk, and several other options.

BLACKSHIP COMPUTER SYSTEMS INC.

Blackship 386SX/20NB

INTELEC CORP.

Intelec INT-NBSX20-40

BY BRUCE BROWN The Blackship 386SX/20NB and the Intelec INT-NBSX20-40 are essentially the same computer: a basic 386SX/20 notebook made by Taiwan-based Chaplet Systems. You've seen it under the Altec Technology Corp. and New MMI Corp. labels as well, where it came with a Sharp screen. The Blackship Computer Systems and Intelec Corp. models reviewed here have an Epson/Sanyo screen.

The two are almost identical internally, except that the Intelec model has a different version of the VLSI chip set. At $1,899, the INT-NBSX20-40 costs $96 less than the 386SX/20NB ($1,995) for the *PC Magazine* configuration. Intelec also throws in a copy of *Microsoft Works*.

Each of the models measures just 2.5 by 11.5 by 8.5 inches (HWD) and weighs 6.6 pounds with the battery installed. If you add the 1.8-pound AC adapter (2 by 3.3 by 7 inches), standard carrying case, and extra 1.3-pound battery, the total package comes to nearly 12 pounds. The AC adapter, an extra battery or two, cables, and a mouse fit into a separate compartment that attaches to the case with Velcro.

The sturdy fold-down cover on the back of the system lets you access four ports: one parallel, one serial, one expansion, and one VGA. Since there is only one serial port and no provision for an internal modem, you can't use a mouse and a modem at the same time.

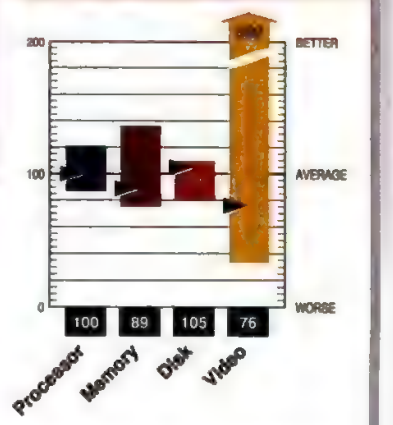
Battery life, rated at about 2 hours by each company, approximated that on our Battery Rundown test. The Blackship unit's battery kept the system going for 1 hour 52 minutes; the Intelec unit's for 2 hours 3 minutes. Charging takes 6 hours,

Also based on a computer from Chaplet Systems, the Blackship 386SX/20NB (right) and the Intelec INT-NBSX20-40 have Epson screens.

Blackship 386SX/20NB

Battery Life: 1 hour 52 minutes.

TEST RESULTS



In Short: The Blackship 386SX/20NB, in the $1,995 *PC Magazine* configuration, gave us no surprises. Its keyboard and screen are fair, and the battery life is adequate. Intelec sells the same machine for $96 less, bundled with *Microsoft Works*. Since the Intelec INT-NBSX20-40 also had better test scores, buy that one instead.

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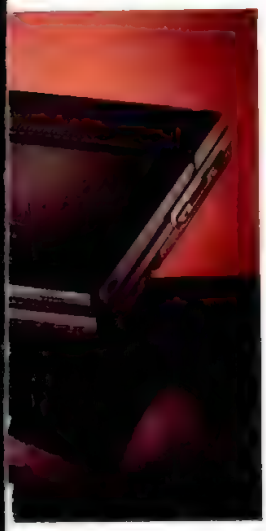

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INTELLIGENT POWER MANAGEMENT: Your new ZEOS notebook features an intelligent programmable power management system if you wish to use it. Based on the length of time since your last keystroke, you may reduce CPU speed, display screen backlighting etc. Full power is immediately restored at the stroke of any key. The system even knows *not* to use the power management system when you are operating on AC power!

CHECK IT OUT!

Now, you can take desktop computing power anywhere! Your ZEOS notebook has many features of obvious importance. Also, there are a number of features that are subtle yet critical to your ultimate satisfaction. We'll go over them here one by one. We think you'll agree your new ZEOS Notebook is the one for you!

SYSTEMS STATUS AT A GLANCE: Yes, monitor eight key system components at a glance! We've equipped your new notebook with eight LED indicators which monitor disk access, keyboard functions and power status. There is even an audible alarm which may be programmed to inform you of a low battery condition and to let you know if the cover is closed with the power on. Now that's one smart notebook!

DESKTOP KEYBOARD FEATURES: We're talking 82 full size keys with full 101-key emulation. And the keyboard isn't squeezed either. The distance between the "Q" key and the "[" (left bracket) key measures 7.5 inches, just as PC Magazine suggests. The keys are of standard size, plus touch typists will love our full 3.5mm keystroke. Type for hours and love it!

CONNECTIVITY AND I/O: Keeping in touch is easy when you order our internal MNP® Class 5, 2400 baud Send/Receive Fax Modem (9600 baud in Fax mode). Simply plug in the phone line and dial away. How about I/O ports? Many notebooks don't have them and if they do they're often non-standard. But your ZEOS notebook has *industry standard I/O*—serial, parallel and VGA. Just like your desktop!

FCC & UL APPROVALS: Your new ZEOS notebook features both FCC Class B and UL approvals. We've also met CSA and VDE requirements too, just for good measure. Quality and reliability.

WATCH THE DETAILS TOO: Like memory expandability. One Meg comes standard, you can also order a total of 3 or 5MB as a factory option. And lots of other details. Like a recessed power-on reset button, a soft carrying handle, built in speaker and more. You're going to love it! And there's no reason to wait.

CALL NOW TOLL-FREE:

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New ZEOS Notebook Prices.
The only way to improve the best.

12 MHz '286
Now Only $1295

16 MHz '386 SX
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12 MHz '286, 16 or 20 MHz '386 SX, Hard Drive,
Floppy Drive, VGA, 7 lbs., Beautiful.

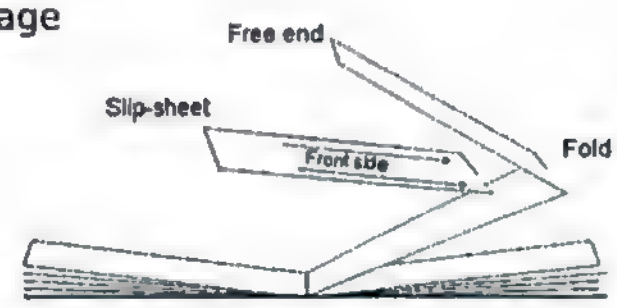
Now is Your chance
to own
the very best!

Folded edge of the page

GbsSlipSheet-001

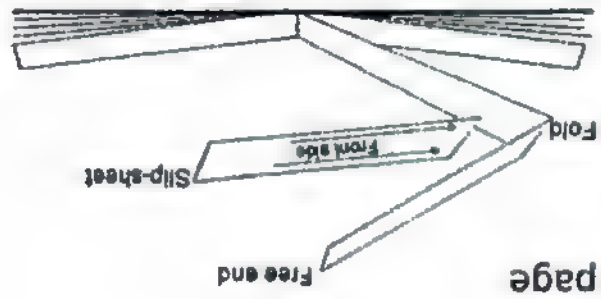
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

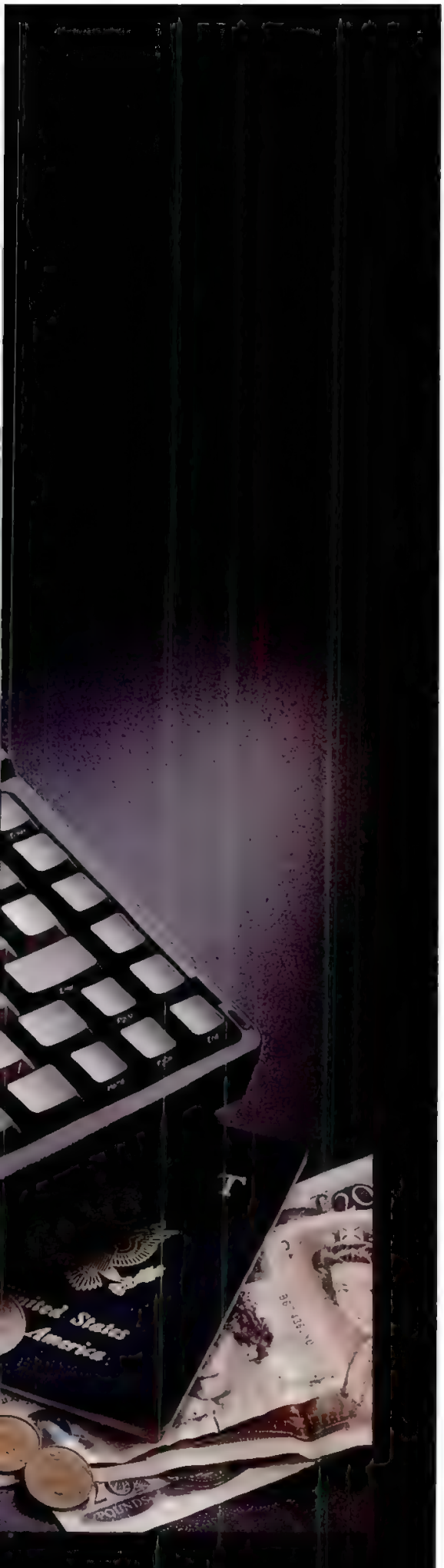


Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side



OWN THE INCOMPARA

The
for L

PC Magazine's Editor's Choice, PC World's Best Buy, Computer Shopper readers vote it Best Buy of 1991, the praises go on and on. Sensational... The best price-performer... Astonishing Value... A Steal... The number one Contender..." The experts love it! And you're sure to love it too, particularly at these great new prices!

As PC Magazine said, the ZEOS Notebook "offers a top notch combination of power, weight, features and price..." And they said that before they even knew about these great new prices! Now, you can buy the ZEOS Notebook as a 286-12 for only $1295. Or, power up to the incredible 386SX-16 for only $1495. And if you want even more power move right into the ZEOS Notebook 386SX at 20MHz for only $1795. Hot Notebooks at really hot prices!

ZEOS '286 *ZEOS '386SX* *ZEOS '386SX*

ZEOS. Perhaps the most awa

INCREDIBLE DESKTOP FEATURES IN A NOTEBOOK.

Owning your new ZEOS Notebook is really like owning a fully featured desktop that you can take with you anywhere. Complete with a 20 megabyte hard drive standard (with a 60MB option), 1.44 floppy disk drive and crisp 10" VGA display there is nothing else like it at anywhere near the price.

Your ZEOS Notebook's rock solid quality, plus performance, ease of use and durability as well are just some of the features that have propelled the ZEOS Notebook into the reviewers limelight. Take our large VGA display for instance.

The ultimate in sparkling clarity, it features advanced fluorescent backlighting for truly vivid VGA graphics. Larger than many others, this is one display you'll truly enjoy using. And that's just the beginning of a long list of performance features that make your new ZEOS Notebook the one to own.

From

Too, you're sure to appreciate your built in 1.44 Megabyte 3.5 inch floppy drive. It makes loading software and transferring files a breeze. Of course accessing your data quickly is just as important. That's where your high performance hard drive comes in.

Your new system comes standard with one of the industry's fastest and quietest hard disk drives—so fast and so quiet you'll hardly know it's there. With 20 Megabytes standard, we also offer a 60 Megabyte option for even more high speed storage!

But the features of your incredible ZEOS Notebook don't stop just there. Detail after detail we're giving you more than anyone else. Much more, for much less. Take a closer look.

DETAILS MAKE THE DIFFERENCE!

For instance, the battery system of your new Notebook is the most advanced on the market. You can quick charge, or trickle

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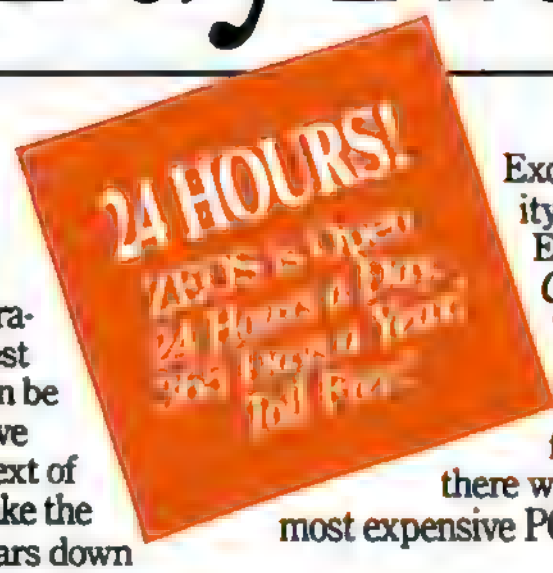
ZEOS IS THE LEADER

10 Good Reasons To Buy From ZEOS®



Reason #1

"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but *eight* times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

Dazzling Performance.

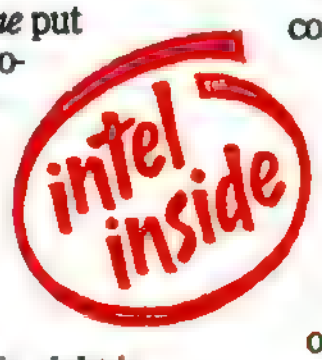
In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.



Reason #4

Value.

InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent." *Personal Computing* said, "ZEOS...is the best value we've come across...its performance is right up there with the slickest, most expensive PCs you can buy."

Reason #5

Warranties and Guarantees.

ZEOS believes in its products. That's why we offer each and every customer our 30 Day Absolute Satisfaction Money Back Guarantee, no questions asked. Plus, our One Full Year Limited Warranty and Express Parts Replacement Policy. Optional On Site Service is available too. Call for details.

Reason #6

24 Hour Toll Free Technical and Sales Support.

At ZEOS, the customer is #1. That's why we invented 24 Hour a Day Tech Support. For *your* convenience. If you buy a product from us we feel we should be there to help, any time of the day or night. Give us a call Toll Free! 800-423-5891. Anytime!

Reason #7

Experience.

Almost unique in the mail order computer industry, ZEOS maintains its own chip level Research and Development staff. In addition to Systems Manufacturing, we also operate our own Board Level Manufacturing facility.

ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8

A Sterling Reputation.

In magazine after magazine and review after review ZEOS systems are cited for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

Reason #9

Easy to Buy.

ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, Discover, American Express, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

And now the Z•CARD! It's your very own ZEOS Credit Card and you can apply today. With the Z•CARD you can charge your ZEOS purchases and pay in easy monthly installments. It's just like a Bank Card. Why not apply for your Z•CARD now!

Reason #10

You're Going to be Very Satisfied.

When it comes right down to it, you're going to be very satisfied with your new ZEOS system. Our goal is your complete satisfaction. And that's our commitment to you. To quality. To performance. To reliability and support. To *Value*. We don't just say it, *we Guarantee it!*

FAX Orders Dial: 612-633-1325
In Minnesota Call: 612-633-4591
MasterCard, VISA, Discover, AmEx, Z•Card and COD
Open 24 Hours a day, 365 Days a year.

Order Now Toll Free

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Fill out your Z•Card™ Application and mail it today to **ZEOS International, Z•Card Processing Center, 530 5th Avenue N.W., St. Paul, MN 55112.** We'll give you a call as soon as your credit line is established!*

Please complete all appropriate sections, *providing at least two years residence and employment history.* **THIS IS NOT A CREDIT AGREEMENT!** One will be sent to you upon authorization of an account. (This Form Must Be Signed To Process Your Order.) All Financed Purchases Are Subject To Credit Approval. **If You Have Any Credit Questions, Please Call 800-421-8942 For Assistance.** Thank You!

A married person may apply for individual credit. I am applying for (please check appropriate box):

☐ **JOINT CREDIT** with another person. Complete entire application.

☐ **INDIVIDUAL CREDIT** but rely on income or assets of another person as a basis for repaying the credit requested. Complete entire application.

☐ **INDIVIDUAL CREDIT.** Do not complete Section C.**

**If you are a married Wisconsin applicant, you must provide your spouse's information as indicated, even though your spouse may not be signing the contract.

NOTICE TO WISCONSIN APPLICANTS: YOU MUST DISCLOSE YOUR MARITAL STATUS:

☐ married ☐ unmarried ☐ legally separated

A: YOUR PERSONAL INFORMATION

Name _____

Home Phone (_____) _____

Soc. Sec. No. _____ Date of Birth ___/___/___

Address _____ Apt. _____

City _____ State _____ Zip _____

Since? (Mo./Yr.) _____ ☐ Buy ☐ Rent ☐ Other _____

Previous Address _____

City _____ State _____ Zip _____

Employer _____ Since? (Mo./Yr.) _____

Monthly Gross Salary $ _____ Daytime Bus. Phone (_____) _____

Previous Employer _____ From - To

Occupation _____

Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as basis for repaying this obligation.

Additional Monthly Income $ _____ Source _____

Name & Address of Nearest Relative Not Living With You _____

_____ Relationship _____

B. CREDIT INFORMATION

PLEASE TELL US IF YOU HAVE: Checking Account ☐ Yes ☐ No; Savings Account ☐ Yes ☐ No

	Y/N	How Many?		Y/N	How Many?
Bank Loan	___	_____	Dept. Store Charge Card	___	_____
VISA	___	_____	Credit Union Account	___	_____
MasterCard	___	_____	Other Major Charge Cards	___	_____
Finance Company Loan	___	_____			

C. JOINT APPLICANT INFORMATION

Joint Applicant's Name _____

Soc. Sec. No. _____ Date of Birth ___/___/___

Address _____ Apt. _____

City _____ State _____ Zip _____

Home Phone (_____) _____ Date of Residence _____ (Mo./Yr.)

Joint Applicant's Employer _____ Since? (Mo./Yr.) _____

Bus. Phone (_____) _____ Monthly Gross Salary $ _____

CUSTOMER AUTHORIZATION

I authorize ZEOS International, Ltd. or its assignees to investigate credit records and to report my performance hereunder to credit agencies. I hereby certify that the following information is furnished to you for the purpose of obtaining credit and is true and correct to the best of my knowledge and belief.

Applicant's Signature _____

Date _____

Joint Applicant's Signature _____

Date _____

FOR MARRIED WISCONSIN APPLICANTS:
I acknowledge that the obligation described herein is being incurred in the interest of my marriage or family.

Buyer's Signature _____ **Date** _____

There are costs associated with the use of this credit card. To obtain more information about these costs, call us at 800-421-8942 or 612-635-0613 or write to ZEOS, Z•Card Processing Center, 530 5th Avenue N.W., St. Paul, MN 55112.

NY – A consumer credit report may be requested in connection with this application or in connection with updates, renewals or extensions of any credit granted as a result of this application. If I subsequently ask for this information, I will be informed whether or not such a report was requested and, if so, the name and address of the agency that furnished the report.

OH – THE OHIO LAWS AGAINST DISCRIMINATION REQUIRE THAT ALL CREDITORS MAKE CREDIT EQUALLY AVAILABLE TO ALL CREDITWORTHY CUSTOMERS AND THAT CREDIT REPORTING AGENCIES MAINTAIN SEPARATE CREDIT HISTORIES ON EACH INDIVIDUAL UPON REQUEST. THE OHIO CIVIL RIGHTS COMMISSION ADMINISTERS COMPLIANCE WITH THIS LAW.

*Financing not available in Alaska, Hawaii or outside the continental U.S.

CIRCLE 115 ON READER SERVICE CARD

INEXPENSIVE 286 AND 386SX NOTEBOOKS: SUMMARY OF FEATURES

List price (*PC Magazine* configuration) To facilitate comparisons, we are citing prices for similarly equipped machines. The configuration we requested for the 15 notebook PCs includes 2MB of RAM, a 40MB hard disk, a VGA display subsystem, DOS 5.0 or 4.01, and an AC power adapter.

Distribution channel Some machines are sold directly through mail order, others through dealers. Dealers have previously offered discounts of 25 percent or more off the list price; however, an industry-wide price restructuring has cut these discounts in many cases. *PC Magazine* views a 15 percent discount as typical.

Weight The table indicates the total weight of the notebook and battery, measured in pounds.

Motherboard manufacturer Some machines are based on motherboards made by major manufacturers, although their other components may vary.

Chip set manufacturer indicates which company makes the logic that connects the CPU with the other functions managed by the system board. Chip sets that use VLSI (very large-scale integration) technology reduce the discrete component count, which in turn helps reduce power consumption and increase component life.

The **BIOS version (or date)** can affect PC Magazine Labs' benchmark test results. A machine with a different BIOS may perform differently.

System shadowing/Video shadowing Shadow RAM is a technology that loads system BIOS or video BIOS from slower ROM into faster RAM on boot-up. Shadowing uses RAM located between 640K and 1MB.

Installable RAM indicates the minimum and maximum amount of memory that can be installed in the unit.

Proprietary expansion port Some machines have an expansion port that enables the system bus to be connected to external devices, such as an expansion station or external floppy disk drive.

Expansion slots refers to machine-specific slots most commonly used by modems and memory modules. Sometimes the slots can also be used for network adapters or fax modems. **User-accessible** means the user can add cards to this slot rather than ship the unit to the dealer or manufacturer.

An **expansion unit,** also called a docking station or expansion station, provides additional space for standard expansion cards and hard disks, tape drives, or floppy disk drives.

Screen manufacturer Most vendors purchase liquid crystal displays from outside sources.

Gray scales at maximum resolution indicates how many shades of gray the unit can display in VGA mode.

Video chip set manufacturer indicates which company makes the video logic that drives the LCD screen and any external monitor hookup.

The **keyboard** section shows the **total** number of keys, the number of **function** keys (10 or 12), and the number of **cursor** keys (4 or 8). If you have only 4 cursor keys and you need to access PgUp, PgDn, Home, or End, you must hold a function key and tap one of the arrow keys—an inconvenient extra step. This section also shows whether or not the notebook has an external numeric **keypad connector** and/or an external **keyboard connector**.

Software refers to any programs bundled with the system, free of charge. (The *PC Magazine* configuration includes DOS 5.0—or, if it is not available, DOS 4.01—to allow more accurate price comparisons.)

Internal modem type includes the speed, list price, and compression scheme (when applicable) of the vendor's modems. Modems that function at 2,400 bits per second and faster benefit from built-in error correction. *MNP 5 compression* is the most widespread form of data compression in use and includes MNP 2 through MNP 4 error correction. Whenever possible, you should consider MNP 5 compression a minimum requirement.

Power supply wattage, voltage We state the output wattage of each unit's power supply. This specification is important for users who want to add peripherals. If a machine has dual voltage, a switch on the power supply permits use with either 110- or 220-volt current; the unit usually selects the appropriate voltage automatically.

Rated battery life is the vendor's rating for the internal battery or batteries, measured in hours. PC Labs independently tests battery life and reports the results in the benchmark test section.

Voltage, Amp-hours shows the voltage and ampere-hour ratings of the notebook's internal battery. We also measure the charge time with the unit on and off.

Shutdown includes such features as automatic display dimming or blanking, automatic hard disk shut-off (now common to most portables), slowing or halting the CPU, and removing power from I/O ports (modem and serial ports) when the machine is not in use.

The **transformer size** and **weight** can vary significantly among machines with similar power needs.

FCC Class B identification number The Federal Communications Commission's Class B certification shows that an electronic device has sufficiently low radio-frequency emissions to be used in the home; the less stringent Class A certification restricts devices to the office. Portable PCs must have Class B certification and an identification number. To verify any system's status, you may dial up the Public Access Link, the FCC's own bulletin board service, at 301-725-1072.

CONTINUES

WE DESIGNED A POWERFUL 386SX FOR APPEARANCE SAKE.

INTRODUCING PC10 – THE BRAINS OF AN IBM,® THE BEAUTY OF A MACINTOSH.®

Cardinal's PC10 is the new IBM compatible workstation that looks as great as it performs. In one neat sleek package, the PC10 sports a crisp 12" VGA monitor and delivers all the 386 power and expandability needed for today's demanding Windows,™ OS/2® and Novell® applications.

Just plug in the one power cord and you're ready to go. And the compact PC10 goes anywhere you work – at home or in the office – with plenty of room to spare on any crowded desk. Plus there's room to grow with high-capacity memory, hard disk options, and two standard 16-bit expansion slots for add-ons like fax modems and network cards.

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- 80386SX, 16Mhz 0 wait state (25Mhz, cache options)
- 1MB, up to 16MB on-board RAM
- Integral 12" VGA grayscale monitor
- 1.44MB 3.5" Floppy Drive
- 40/80MB Hard Disk options
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*Suggested retail price. Dealer prices may vary. Mouse shown is optional equipment. All names, products and services mentioned are the trademarks or registered trademarks of their respective organizations.

INEXPENSIVE 286 AND 386SX NOTEBOOKS: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Altec 386SX/20 NB	Blackship 386SX/20NB	Fora NBS-386S/20	Insight 386SX-20 Notebook
List price (*PC Magazine* configuration)	$1,750	$1,995	$1,975	$1,995
Distribution channel	Dealers, direct	Direct	Dealers, direct	Direct
STANDARD CONFIGURATION				
Processor type, hard disk capacity	20 MHz, 40MB	20 MHz, 40MB	20 MHz, 40MB	20 MHz, 60MB
Dimensions (HWD, in inches)	2 x 12 x 8.5	2 x 11.7 x 8.5	2 x 11 x 8.2	2.1 x 11.3 x 8.3
Weight (pounds)	6.5	6.5	6.6	7.2
Display area (H x W, in inches)	5 x 6.5	5.1 x 7	5 x 7	5.8 x 7.6
Motherboard manufacturer	Chaplet	Chaplet	Sampo	Chicony
Chip set manufacturer	VLSI	VLSI	Intel	VLSI
BIOS version (or date)	AMI (June 1990)	AMI (June 1990)	Phoenix 1.01	AMI (August 1990)
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■
MEMORY				
Installable RAM	2MB–8MB	2MB–6MB	1MB–5MB	1MB–5MB
User-installable	■	■	■	■
INPUT/OUTPUT				
Parallel, serial, mouse ports	1, 1, 0	1, 1, 0	1, 1, 0	1, 2, 0
Proprietary expansion port	■	■	■	❑
EXPANSION BUS				
Expansion slots	None	None	1 memory, 1 modem	1 memory
User-accessible	N/A	N/A	■	■
Price of expansion unit	$320	$325	N/A	N/A
VIDEO				
Screen manufacturer	Sharp	Epson/Sanyo	Sharp	Sanyo
Gray scales at maximum resolution	32	32	16	16
Video chip set manufacturer	Cirrus Logic	Cirrus Logic	Cirrus Logic	Cirrus Logic
Super VGA out	❑	❑	■	❑
KEYBOARD				
Keys: total, function, cursor	80, 10, 4	81, 10, 4	80, 10, 4	83, 10, 4
Keypad connector/Keyboard connector	❑/■	❑/■	❑/■	■ ■
SOFTWARE				
DOS	5.0	5.0	5.0	5.0
Other bundled software	EMS.COM, Microsoft Windows 3.0, utilities	EMS.COM, utilities	*BitComm*, *BitFax* utilities, video drivers	*Eagle* utilities, mouse drivers
MODEM				
Internal modem type	None	None	2,400/4,800-bps data/fax	None
Price	N/A	N/A	$245	N/A
POWER SUPPLY AND BATTERY				
Power supply wattage, voltage	40, dual	60, 15	24, dual	5, 16.5
Rated battery life (hours)	2.5	2–3	2.5	2–3
Tested battery life (hours:minutes)	2:06	1:52	2:06	1:55
Charge time with unit on, off (hours)	6, 6	6, 6	5.5, 4	4, 2
Voltage, Amp-hours	9.6V, 2.5Ah	9.6V, 2.5Ah	7.2V, 2.5Ah	10.8V, 1.8Ah
Shutdown:				
Display/disk	■/■	■/■	■ ■	■/■
System/peripherals	❑/❑	❑/❑	■ ■	■/❑
Transformer size (inches)	2 x 7 x 3.5	2 x 7 x 3.3	2 x 6 x 3.5	1.7 x 5.8 x 2.9
Transformer weight (pounds)	1.4	1.8	1.2	1.3
MISCELLANEOUS				
Coprocessor support	80387SX	80387SX	80387SX	80387SX
Setup in ROM Password in ROM	■ ❑	■ ❑	■ ■	■ ■
Warranty	1 year	1 year	1 year	1 year
Service	Vendor	Vendor	Vendor	Vendor
FCC Class B identification number	GXLNBA386SX	GXLNBA386	ARFNBL36X20	E8HNB5620

—Editors' Choice ■—Yes ❑—No N/A—Not applicable: The product does not have this feature

AMI—American Megatrends Inc., C&T—Chips and Technologies Inc., VLSI—Very Large Scale Integrated Technology Inc

Intelec INT-NBSX20-40	Master Cascade Notebook Model 203	Maxtron 386SX-20 Note Book Model 303V	MicroStar NoteStar NP-902
$1,899	$1,859	$1,995	$1,730
Direct	Dealers, direct	Dealers	Dealers
20 MHz, 40MB	20 MHz, 40MB	16 MHz, 60MB	12 MHz, 41MB
2.3 x 11.5 x 8.5	2 x 12 x 10.5	2.3 x 11.5 x 8.5	2.1 x 12 x 9 5
6.6	7.8	6.5	8.2
5.1 x 7	5 x 6.8	5 x 7.5	5.8 x 7.8
Chaplet	Notebook Computer	Hi-Tron	Modern
VLSI	Headland	Headland	C&T
AMI (June 1990)	Award (October 1989)	Award 3.11	AMI (June 1990)
■/■	■/■	■/■	■/■
2MB–8MB	1MB–5MB	2MB–4MB	1MB–8MB
■	❑	❑	■
1, 1, 0	1, 2, 0	1, 1, 1	1, 1, 0
■	■	❑	❑
None	None	None	None
N/A	N/A	N/A	N/A
$395	N/A	N/A	N/A
Epson	Sharp	Hitachi	Sanyo
32	32	32	32
Cirrus Logic	Cirrus Logic	Cirrus Logic	C&T
❑	❑	❑	❑
80, 10, 4	82, 10, 8	80, 12, 4	83, 10, 8
❑/■	■/❑	■/■	❑/■
5.0	5.0	5.0	4.01
EMS.COM, *Microsoft Works*, utilities	MM.SYS, utilities	VGA utilities	*Follow-UP, UFO*
None	None	None	2,400-bps; 2,400-bps MNP 1–5; 2,400/9,600-bps fax/modem
N/A	N/A	N/A	$168, $209, $259
60, 15	48, 24	36, dual	60, dual
2	2–3	2	2.8
2:03	2:18	1:39	4:32
6, 6	2, 2	8, 4	9, 8
9.6V, 2.5Ah	8.4V, 1.4Ah	12V, 1.4Ah	12V, 1.4Ah
■/■	■/■	■/■	■/■
❑/❑	❑/❑	■/❑	■/❑
2 x 7 x 3.3	2.2 x 6.5 x 3	2.5 x 6 x 3	1.3 x 6.3 x 3
1.8	1.6	1.7	1.5
80387SX	80387SX	80387SX	80287
■/❑	■/❑	■/❑	■/❑
1 year	1 year	1 year	1 year
Vendor GXLNBA386	Vendor FMA2400	Dealer FFXKSN-386H	Vendor GS6NP-902S

CONTINUES

whether the system is on or off. Extra batteries sell for $79 each from either vendor. For $139, Intelec sells an external charger that brings the battery to full charge in 4 hours—a convenience, perhaps, but also an extra-cost item and something more to carry.

Power-conservation features are limited. The Blackship and Intelec notebooks have power-down utilities only for the hard disk and video, each with user-selectable inactivity periods before power is cut. There is no way to turn off or reduce power to ports, memory, or the full system, and there's no sleep mode. You activate the drive and screen power savers by running a separate utility for each from the DOS command line—best done in AUTOEXEC.BAT. The power switch, located near the top left of the system, turns off automatically when the case cover is closed—a nice touch.

The 640-by-480-resolution LCD screen is a standard item, the same as or similar to many available. Some of the Chaplet Systems units come with a Sharp screen. Video performance, as driven by the 8-bit Cirrus Logic chip set, is very close for all four systems, and the only way to tell the difference between the screens is to look at the computer's serial number: If it starts with an *N*, it's an Epson screen; with an *S*, it comes from Sharp. At 5.1 by 7 usable inches, the display is a bit small, but it is bright enough and has enough contrast to run Microsoft Windows 3.0. You have the option of connecting an external VGA monitor, which is great if you work in a single location for an extended amount of time.

The notebook's 80-key keyboard is passable. Most of the keys are standard

FACT FILE

Blackship 386SX/20NB
Blackship Computer Systems Inc., 2031 O'Toole Ave., San Jose, CA 95131; 800-531-7447, 408-432-7500.
List Price: $1,995.
Tested Configuration: 2MB RAM, 40MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case.
Options: 60MB unit, $200. 2MB RAM upgrade, $250; 4MB RAM upgrade, $425; external floppy disk drive, $275; 80387SX coprocessor, $175; 17-key numeric keypad, $80; 33-key numeric keypad, $140; expansion chassis, $350; extra battery, $79; car battery adapter, $119; network adapter (only with expansion chassis), $239; 2,400-bps modem, $139.

CIRCLE 422 ON READER SERVICE CARD

INEXPENSIVE 286 AND 386SX NOTEBOOKS: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	MicroStar NoteStar NP-903	Micro Telesis Jetbook-386SX	National Micro Systems Flash NT386SX-20	New MMI CMO NB-320SX	Standard SX/20 Notebook
List price (*PC Magazine* configuration)	$2 077	$1,699	$1,999	$1,895	$1,995
Distribution channel	Dealers	Direct	Direct	Dealers, direct	Dealers, direct
STANDARD CONFIGURATION					
Processor type, hard disk capacity	16 MHz, 41MB	20 MHz, 40MB	20 MHz, 40MB	20 MHz, 40MB	20 MHz, 40MB
Dimensions (HWD, in inches)	2.1 x 12 x 9.5	2 x 11 x 8.5	2.5 x 11.4 x 8.6	2 x 12 x 8.5	2 x 11 x 8.2
Weight (pounds)	8	6.7	7.1	6.5	6.5
Display area (H x W, in inches)	5.8 x 7.8	5.3 x 7.2	5.3 x 7	6.5 x 5	5 x 7
Motherboard manufacturer	Modern	Jetta	Amrel	Chaplet	Sampo
Chip set manufacturer	Headland	C&T	Headland/Acer	VLSI	Intel
BIOS version (or date)	AMI (June 1990)	Award 3.10	AMI (June 1990)	AMI (June 1990)	Phoenix 1.01
System shadowing/Video shadowing	■ ■	■ ■	■/❑	■ ■	■ ■
MEMORY					
Installable RAM	2MB–8MB	1MB–16MB	1MB–5MB	2MB–6MB	1MB–5MB
User-installable	■	■	■	■	■
INPUT/OUTPUT					
Parallel, serial, mouse ports	1, 1, 0	1, 1, 0	1, 1, 0	1, 1, 0	1, 1, 0
Proprietary expansion port	❑	■	■	■	■
EXPANSION BUS					
Expansion slots	None	1 memory, 1 modem	1 memory, 1 modem	None	1 memory, 1 modem
User-accessible	N/A	■	■	N/A	■
Price of expansion unit	N/A	$279	$425	$369	N/A
VIDEO					
Screen manufacturer	Sanyo	Sanyo	Sharp	Sharp	Sharp
Gray scales at maximum resolution	64	64	32	32	16
Video chip set manufacturer	Headland	Cirrus Logic	Cirrus Logic	Cirrus Logic	Cirrus Logic
Super VGA out	❑	❑	❑	❑	■
KEYBOARD					
Keys: total, function, cursor	83, 10, 8	86, 12, 4	82, 12, 8	80, 10, 4	80, 10, 4
Keypad connector/Keyboard connector	❑/■	■/■	■/■	❑/■	❑/■
SOFTWARE					
DOS	4.01	5.0	5.0	5.0	5.0
Other bundled software	*Follow-UP*, Microsoft Windows 3.0, *UFO*	VGA utilities	*BitComm*, *BitFax*, *Eagle* utilities	EMS.COM, utilities	*QuickLink II*, utilities, video drivers
MODEM					
Internal modem type	2,400-bps, 2,400-bps MNP 1–5; 2,400/9,600-bps fax/modem	2,400-bps MNP 5	2,400-bps MNP 5 send/receive fax	None	2,400/4,800-bps send/fax
Price	$168, $209, $259	$125	$150	N/A	$199
POWER SUPPLY AND BATTERY					
Power supply wattage, voltage	60, dual	180, dual	25, dual	40, dual	24, dual
Rated battery life (hours)	2.8	2.7	2–3	2	2.5
Tested battery life (hours:minutes)	3:02	1:46	2:50	2:12	1:57
Charge time with unit on, off (hours)	9, 8	6, 5	5, 2	6, 4	6, 2.5
Voltage, Amp-hours	12V, 1.4Ah	4.8V, 5Ah	4.8V, 4.3Ah	9.6V, 2.5Ah	7.2V, 2.5Ah
Shutdown:					
Display/disk	■/■	■/■	■/■	■/■	■/■
System/peripherals	■/❑	■/❑	■/❑	❑/❑	■/■
Transformer size (inches)	1.3 x 6.3 x 3	2 x 7.4 x 2.8	2.3 x 6.4 x 3	2 x 7 x 3.5	2 x 6 x 3.5
Transformer weight (pounds)	1.6	1.5	1.8	1.4	1.2
MISCELLANEOUS					
Coprocessor support	80387SX	80387SX	80387SX	80387SX	80387SX
Setup in ROM/Password in ROM	■/❑	■/■	■/❑	■/❑	■/■
Warranty	1 year	13 months parts, 2 years labor	1 year	1 year	1 year
Service	Vendor	Vendor	Vendor	Vendor	Vendor
FCC Class B identification number	GS6NP-903	IQ7JETBOOK-386SX	IR5MLT386SX	GXLNBA386SX	ARFNBL36X20

—Editors' Choice ■—Yes ❑—No N/A—Not applicable. The product does not have this feature.
AMI—American Megatrends Inc., C&T—Chips and Technologies Inc., VLSI—Very Large Scale Integrated Technology Inc.

Tangent Model 320N Voyager SX	USA FlexNote 20
$1 999	$1 995
Direct	Direct
20 MHz. 40MB	20 MHz 60MB
2 x 11.5 x 8	2 5 x 11 x 8 5
6 4	6 9
5 x 7	5 x 7.5
Quadtel	Sotek
VLSI	Intel
Quadtel 3.05.05	AMI (July 1991)
■ ■	■ ■
1MB-5MB	1MB-5MB
■	■
1 1 0	1 1. 0
┘	■
1 memory. 1 modem	1 memory. 1 modem
■	■
5-slot. $595	$399
8-slot. $795	
Sharp	Sharp
32	16
Cirrus Logic	Cirrus Logic
■	■
85 12 4	80 10 4
■ ■	┘ ■
5.0	5.0
Eagle utilities	Diagnostics Microsoft Windows 3.0. *PFS.WindowsWorks.* video drivers
2,400/9,600-bps send/receive fax with MNP 5	2,400 9,600-bps send-fax
$349	$169
66. 12	32. dual
2	1 25
1.24	1 47
8. 3	5 2
7.2V. 2.2Ah	7 2V. 2 5Ah
■ ■	■ ■
■ ■	■ ■
1 7 x 5 2 x 2 6	2 x 7 x 3 5
1.1	1 5
80387SX	80387SX
■ ■	■ ■
1 year	1 year
Vendor GT6NB20	Vendor I2ENB320S

ENDS

size, with good travel and quiet action. Ten function keys, slightly smaller than usual, form the top row. Also in the top row are the Ins and Del keys, on the far right. Cursor keys positioned in an L shape double as the Home, End, PgUp, and PgDn keys when activated by a Fn key located in the lower-left corner. You can add an external keyboard by means of a PS/2-style plug; an adapter for AT-style keyboard plugs is included.

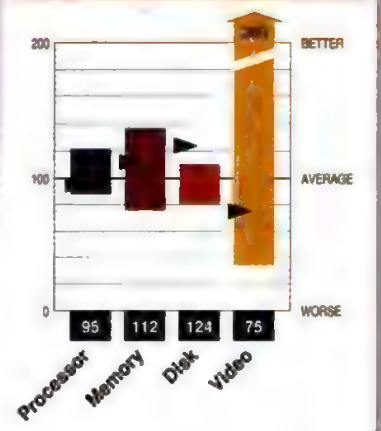
The Chaplet Systems notebook has the potential to handle 8MB of RAM if the original 2MB memory board is desoldered and replaced. But neither Blackship nor Intelec offers this option: Both companies limit memory upgrades to a 6MB maximum.

You can get the Blackship unit with a 20MB hard disk for $1,695 ($300 less than the 40MB price) or with a 60MB hard disk for $2,195 ($200 more). The only hard disk option Intelec sells is 60MB, which at $1,999 costs $100 more than its 40MB system.

Intelec INT-NBSX20-40

Battery Life: 2 hours 3 minutes.

TEST RESULTS



In Short: Intelec's version of the Chaplet Systems notebook computer won't make your pulse race, but its 2-hour-plus battery life, decent screen and keyboard, and better-than-average price all argue in its favor. You can get an internal modem if you want, but you will have to live without error correction. The Intelec model also has a better price than its siblings and is therefore the one to buy.

Both vendors sell a Chaplet Systems external expansion chassis that comes with its own power supply, two full-length ISA 16-bit slots, and a 5.25-inch drive bay. Both charge $350 for the unit. You can buy an external 1.2MB floppy disk drive for $270 from Intelec or $275 from Blackship; the drive attaches to the parallel port.

On our benchmark tests, the Blackship unit's scores were closer to those of the Altec and New MMI notebooks than those of the Intelec unit. The Blackship had faster processor and video times than the Intelec but slower memory and hard disk times.

Both companies have a similar service-and-support mix: one year on parts and labor, with no standard or optional on-site service. If you need maintenance during the warranty period, you pay to ship the computer to the vendor's site; the vendor mirror-ships it back after replacement or repair. For $250, Intelec lets you buy an extended service contract that increases the warranty period to four years.

Besides such usual wish-list items as a lower price, ever-larger drives, and more standard memory, tops on the list for this machine would be to gain a mouse port or another serial port; also, to move the Ins and Del keys to the bottom row of the keyboard and give us dedicated Home, End, PgUp, and PgDn keys.

If you can live with the single serial port and no internal modem, everything else about the system is acceptable. The Intelec INT-NBSX20-40 sells for less than the Blackship 386SX/20NB and offers a few more options, so there is no compelling reason to buy the notebook from Blackship at the current price.

FACT FILE

Intelec INT-NBSX20-40
Intelec Corp., 6075 NW 82 Ave., Miami, FL 33166; 800-683-0969, 305-594-0001.
List Price: $1,899.
Tested Configuration: 2MB RAM, 40MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, *Microsoft Works*, mouse, AC power adapter, carrying case.
Options: 60MB unit, $100. 2MB RAM upgrade, $260; 4MB RAM upgrade, $520; external floppy disk drive, $270; 80387SX coprocessor, $120; 17-key numeric keypad, $75; 33-key numeric keypad, $120; expansion chassis, $350; extra battery, $70; external battery charger, $139; AC power adapter, $88; 2,400-bps modem, $100.

CIRCLE 425 ON READER SERVICE CARD

This is a giant step in

Always a Step Ahead.™

In a recent article, *PC Computing* named only one computer "the ultimate PC."

The Everex™ STEP™ Megacube.™ "Working with the Megacube is sheer joy...It gives me everything I'm looking for," said the reviewer.* Such unequivocal praise is no overstatement. Because with the STEP Megacube, Everex has achieved not one design breakthrough — but several.

A BIG STEP FORWARD LEAVES OTHERS BEHIND.

The powerful combination of Intel's hot i486™/33 CPU chip and Everex's proprietary Advanced Memory Management Architecture (AMMA™), a second level cache of up to 256K, makes for a warp speed of 20.8 MIPS.**

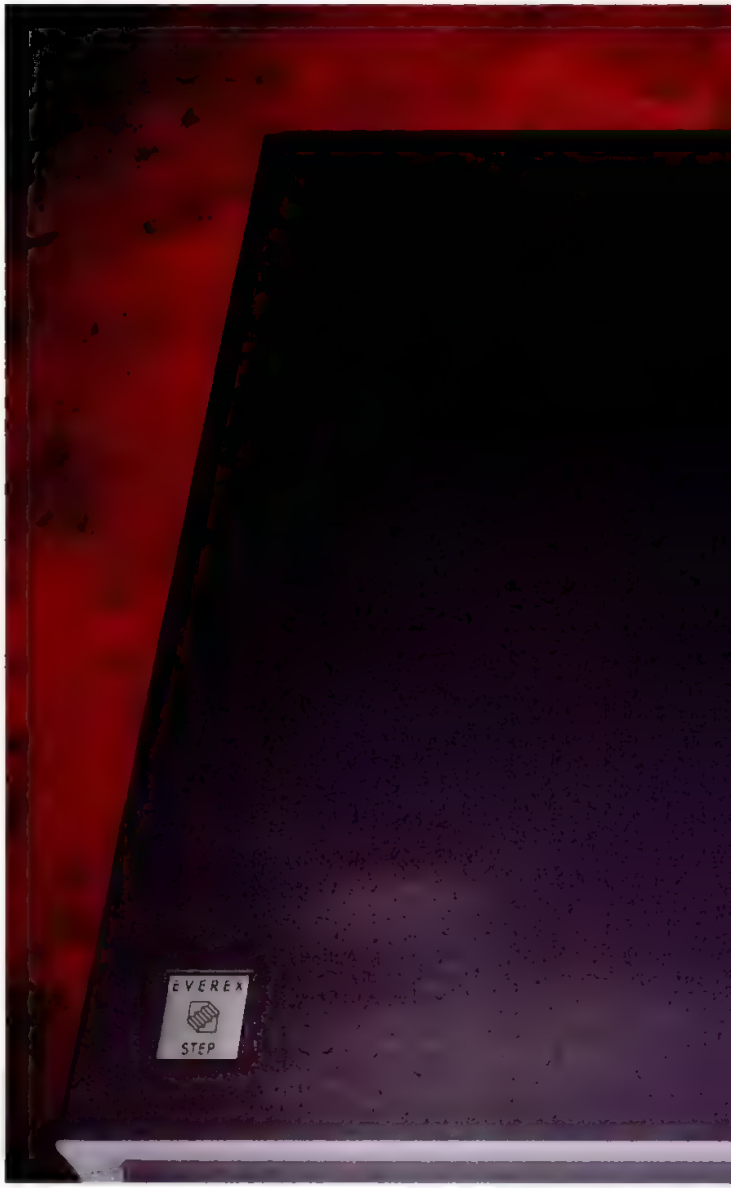
And with 12 expansion slots, 8 drive bays, a 400-Watt power supply, and up to 64MB of memory–enough for even the most demanding applications–the STEP Megacube has more expansion capabilities than any computer on the market today.

intel inside

THE ULTIMATE PC IS THE IDEAL FILE SERVER.

Everex has designed a powerful network server specifically to meet the requests of network and multiuser system administrators like yourself. Not only do you want a topnotch server that's expandable and performs well, but you also want reliability and serviceability.

In the STEP Megacube, you'll find everything you asked for and more. For example, recognizing that security is all-important on a network,

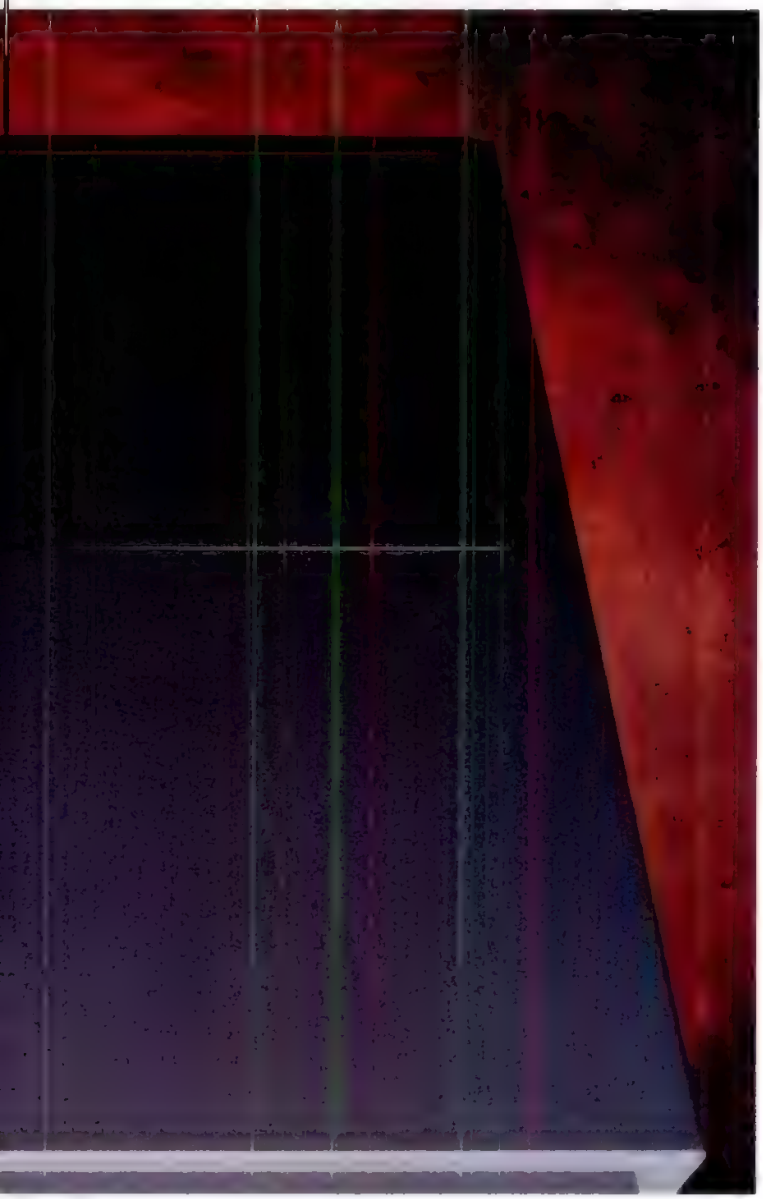


The STEP MegaCube is the first system to incorporate advanced thermal management to prevent problems caused by overheating. The Everex Thermal Management

STEP MEGACUBE 486/33

- 20.8 MIPS
- 486/33 Microprocessor
- 8 Half-height drive bays
- Up to 64MB of RAM
- 256K Cache
- 10 of the expansion slots are EISA
- 400 Watt power supply
- Everex Thermal Management System (ETMS)
- Side panels and drive bays mounted with thumbscrews
- Chassis locks
- Password protection
- Upgradeable to future-generation motherboards

personal computing.



System (ETMS™) maintains lower internal temperatures, and a dual compartmental design separates the microprocessor and disk drives, the hottest system components.

Everex has built in password protection to ensure that data remain safe from unauthorized users. And the STEP Megacube is even available preconfigured for Novell® Netware.

A COMPANY THAT'S ALWAYS A STEP AHEAD.

But file serving is not all the Megacube was designed for. On the contrary, this multifaceted computer performs equally well as a graphics workstation and multiuser system. You won't find a more versatile system anywhere, nor one with so many design firsts.

Megacube design innovations include everything from a distinctive cube design to a unique thermal management system that eliminates reliability problems caused by the heat from high-performance systems. And don't forget the remarkably low base price of $4,559.***

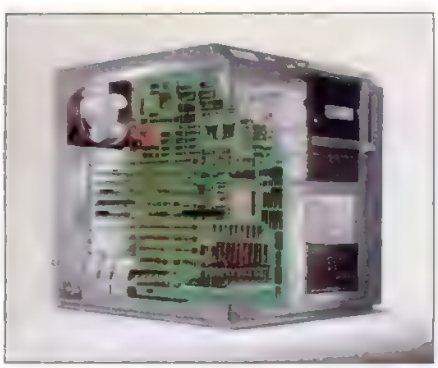
But this should come as little surprise to anyone familiar with Everex and our wide range of quality computer products. At Everex, our mandate is "Always innovate, never compromise."

TAKE A GIANT STEP.

To find out more, call 1-800-258-STEP or mail the reply card.

It's certainly a STEP in the right direction.

The entire interior of the cube is accessible in seconds through sidepanels, using thumbscrews. So it can be easily serviced without being moved, and without removing devices stacked on top of it. Everex has designed a special hydraulically-dampened door to keep dust and contaminants out of components that are accessible from the front of the system.



EVEREX
EVER for EXcellence®

*Reprinted from *PC Computing* June 1991 ©1991, Ziff Communications Company **MIPS Source Intelligent Devices' High Test Benchmarking Software. ***Suggested retail price for Megacube 386/33 with 8 MB RAM International Operations: Canada 800 661 2003, France 331 69 07 60 41, Hong Kong 852 389 2365, Spain 341 430 9212, U.K. 44 81 205 0607 GSA# GS00K90AGS5253 EVER for EXcellence is a registered trademark, and Everex, STEP, Megacube, ETMS, AMMA and Always a Step Ahead are trademarks of Everex Systems. i486 and the Intel Inside Logo are trademarks of Intel Corporation. Novell is a registered trademark of Novell, Inc. ©1991, Everex Systems, Inc.

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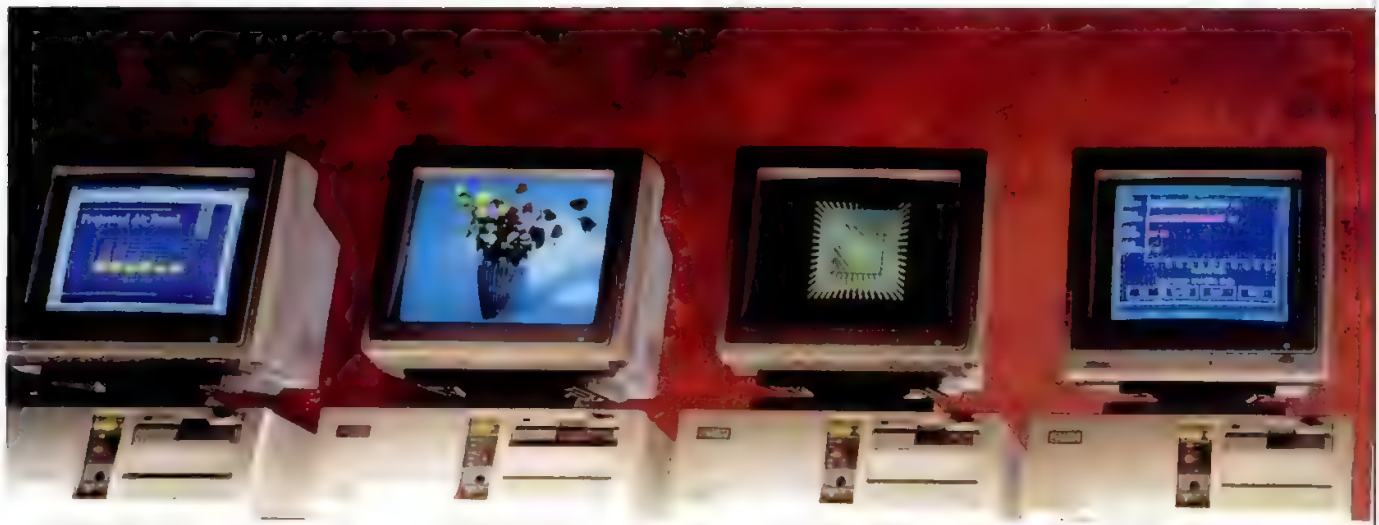

STEP 386SX/16
- 3.5 MIPS*
- 1-16MB RAM
- Starting at $1,499**

STEP 386SX/20
- 4.6 MIPS
- 1-16MB RAM
- Starting at $1,599

STEP 386/25
- 8.1 MIPS
- 1-64MB RAM
- Starting at $2,049

STEP 386/33
- 10.4 MIPS
- 1-64MB RAM
- Starting at $2,499

EVEREX STEP
Always a Step Ahead.™

The STEP Megacube isn't the only Everex STEP™ computer that outruns the competition. Any STEP you take gives you the best combination of price, performance and innovative engineering available in the PC industry.

Key to the STEP's blazing speed is Everex's proprietary Advanced Memory Management Architecture (AMMA), a second level cache of up to 256K.

SEVERAL STEPS THAT LEAVE OTHERS BEHIND.

The STEP line offers Everex's proprietary Advanced Memory Management Architecture (AMMA™), a second level cache of up to 256K. That increases cache hit rates to as high as 99%—maximizing overall performance.

And like the Megacube, the entire STEP line is expandable. Each computer has 8 or more expansion slots. And up to 64MB of RAM (up to 16MB in the STEP 386™SX).

What's more, with an IN STEP direct CPU replacement board, all 386DX STEP computers are easily upgradeable to i486 systems.

STEP's LED display provides detailed status

With every STEP computer, the following items are included free:

	Suggested Retail Value
FREE Windows™	$145
FREE Mouse	$80
FREE MS-DOS™ 5.0	$130
FREE 1-year parts and labor warranty	NC
FREE 1-year on-site service†	$250
	$605

†on-site service also covers all Everex peripherals in the computer system

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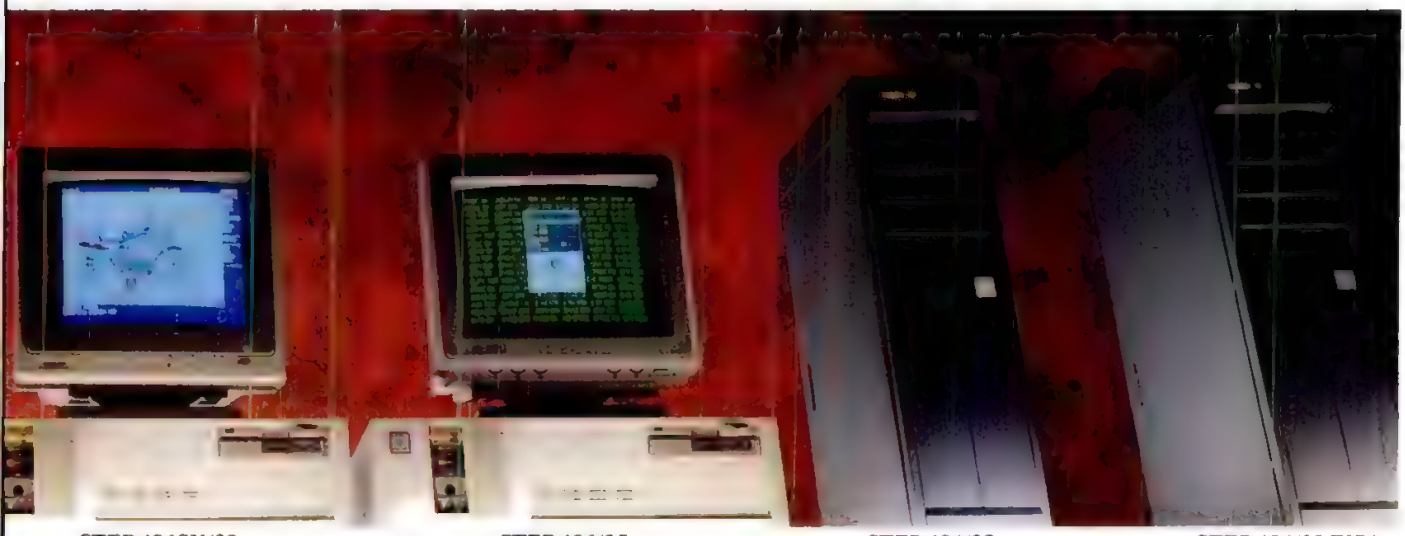

STEP 486SX/20
- 13 MIPS
- 1-64MB RAM
- Starting at $2,999

STEP 486/25
- 16.2 MIPS
- 4-64MB RAM
- Starting at $4,699

STEP 486/33
- 21.7 MIPS
- 4-64MB RAM
- Starting at $4,799

STEP 486/33 EISA
- 20.8 MIPS
- 4-64MB RAM
- Starting at $5,799

and error messages in English—not code. So problems can be identified and remedied faster, resulting in less downtime.

Everex has also added Programmable Configuration Select, so no diskettes or jumpers are needed for setup. And Programmable Drive Tables allow virtually any drive to be installed and used to its fullest capacity.

Should you ever need service, it's comforting to know that every STEP computer is backed by one-year warranties for on-site service and for parts and labor. (A three-year parts and labor warranty is also available.) Knowing Everex, you'd expect nothing less. After all, we insist on quality and reliability in every computer product we sell. In fact, Dataquest*** recently rated Everex number one in customer satisfaction.

Detailed status and error messages appear on the STEP's LED display in English—not in computer code—so troubleshooting time is shortened.

intel inside

TAKE YOUR NEXT STEP.

Call 1-800-258-STEP to find out more about the STEP line or mail the reply card. You'll soon discover how far a STEP can take you.

EVEREX
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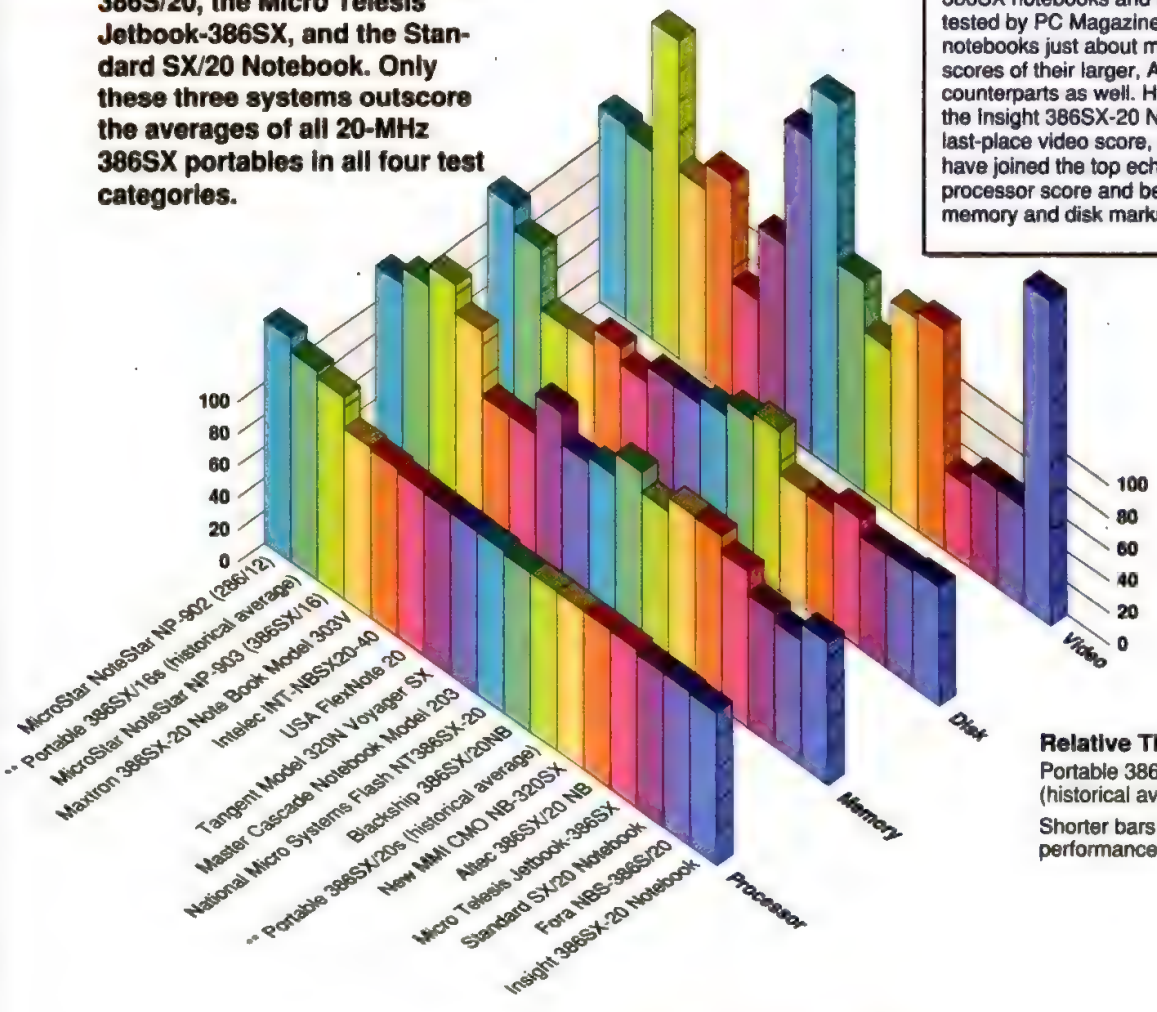
*MIPS Source: Intelligent Devices' High Test Benchmarking Software. **All prices are suggested retail. Actual prices may vary. ***Dataquest PC Customer Satisfaction Study 1990. International Operations: Canada 800-661-2003, France 33 1 69 07 60 41, Hong Kong 852 389 2365, Spain 341 430 9212, U.K. 44 81 205 0607. EVER for EXcellence is a registered trademark, and Everex, STEP, Megacube, AMMA and Always a Step Ahead are trademarks of Everex Systems. 386, i486 and the Intel Inside Logo are trademarks of Intel Corporation. MS-DOS and Windows are trademarks of Microsoft Corporation. © 1991 Everex Systems, Inc.

BENCHMARK TESTS: INEXPENSIVE NOTEBOOKS

For well-rounded notebook performance, turn to the Fora NBS-386S/20, the Micro Telesis Jetbook-386SX, and the Standard SX/20 Notebook. Only these three systems outscore the averages of all 20-MHz 386SX portables in all four test categories.

WHAT THE NUMBERS MEAN

Of the 15 tested units, 3 stand out as top performers: the notebooks from Fora, Micro Telesis, and Standard. In all four categories (processor, memory, disk, and video), this trio outscored the average of all 20-MHz 386SX notebooks and laptops previously tested by PC Magazine Labs. These notebooks just about matched the average scores of their larger, AC-powered desktop counterparts as well. Had it not been for the Insight 386SX-20 Notebook's next-to-last-place video score, that notebook could have joined the top echelon; it has the best processor score and better-than-average memory and disk marks.



Relative Times
Portable 386SX/20 (historical average) = 100
Shorter bars represent better performance.

Lower scores represent better performance.

	Processor (seconds)	Memory (seconds)	Disk (seconds)	Video (seconds)
MicroStar NoteStar NP-902 (286/12)	4.71*	0.69	86.37	4.94
** Portable 386SX/16s (historical average)	4.42	0.75	75.99	4.76
MicroStar NoteStar NP-903 (386SX/16)	4.28	0.82	48.87	8.07
Maxtron 386SX-20 Note Book Model 303V	3.62	0.72	49.49	4.78
Intelec INT-NBSX20-40	3.57	0.50	57.21	5.44
USA FlexNote 20	3.49	0.50	50.42	2.92
Tangent Model 320N Voyager SX	3.47	0.64	57.91	4.83
Master Cascade Notebook Model 203	3.46	0.53	57.78	7.97
National Micro Systems Flash NT386SX-20	3.45	0.55	61.10	9.34
Blackship 386SX/20NB	3.38	0.63	67.56	5.33
** Portable 386SX/20s (historical average)	3.38	0.56	70.99	4.06
New MMI CMO NB-320SX	3.37	0.61	52.01	5.33
Altec 386SX/20 NB	3.37	0.61	51.80	5.55
Micro Telesis Jetbook-386SX	3.35	0.55	58.06	2.04
Standard SX/20 Notebook	3.27	0.47	50.83	2.53
Fora NBS-386S/20	3.27	0.44	51.28	2.53
Insight 386SX-20 Notebook	3.23	0.50	52.71	8.24

* We ran the 80286 Instruction Mix test on this unit. ** Reported for comparison.

HOW WE TESTED

In testing these 15 286/12, 386SX/16, and 386SX/20 notebook systems, we used PC Magazine Labs' Hardware Performance Tests, Release 5.7, with video and system shadowing enabled wherever possible, and we left the buffers at their default values. We used no software disk caches when performing disk benchmark tests, and no RAM-resident programs were loaded for any tests. The margin of error for the processor, memory, and video benchmark tests is 0.05 seconds.

The Insight unit's video demise was due to its 8-bit video implementation, a method used by all companies but Fora, Micro Telesis, Standard, Tangent, and USA Flex. Despite the Tangent Model 320N Voyager SX's 16-bit advantage, its video took more than twice as long as the fastest unit on PC Labs' video test. Tangent's Intel/VLSI chip set–based design yielded processor and memory test scores that were also on the slow side of our historical averages.

Interestingly, the disk scores for the 20-MHz machines were all better than the PC Labs historical average, attesting to recent advances in small-hard-disk technology. The leading 20-MHz disk performer was a Conner 60MB CP-2064 hard disk, as implemented in the Maxtron 386SX-20 Note Book Model 303V. At the other extreme, the Blackship PC showed the poorest disk score—worse than its identical companion, the Intelec INT-NBSX20-40, which used the same Toshiba hard disk. During testing, we swapped the disks between the two machines, and the Intelec unit then performed poorly. Our conclusion: Blackship prepared the Toshiba IDE hard disk improperly.

In a group dominated by 20-MHz 386SX machines were two lesser-powered offerings from MicroStar Computers: a 16-MHz 386SX and a 12-MHz 286. The 286 NoteStar NP-902 performed better than its 386SX companion, the NoteStar NP-903, on the memory and video tests. The 386SX was also a poor performer in those categories, compared with the average of previous 386SX/16s tested by PC Labs. Processor and disk scores for the NoteStar NP-903 were better than average for machines in its class.

■ The **Instruction Mix** benchmark test times a series of tasks specific to the processor. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

■ The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at relatively slow access speeds.

■ The disk score is the sum of the small-record and large-record **DOS File Access** benchmark test times. Each test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. No software cache is employed.

■ The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. A good score indicates that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and write directly to the screen.

FORA INC.

Fora NBS-386S/20

STANDARD COMPUTER CORP.

Standard SX/20 Notebook

BY ALFRED POOR What do Fora's NBS-386S/20 and Standard Computer Corp.'s Standard SX/20 Notebook have in common? Just about everything. Even their prices are only $19 apart. Both are made by Sampo, a Taiwan-based company that makes portables and monitors for mail-order vendors.

Fora, which sells primarily through dealers, charges $1,975 for a 386SX/20 notebook in the *PC Magazine* configuration (2MB of RAM, a 40MB hard disk, utilities including a memory manager, DOS 5.0, a nickel cadmium battery, an AC/DC adapter, and a carrying case). Standard, which sells mostly by mail order, charges $1,995.

Both companies offer a $200 upgrade to a 60MB hard disk. Fora charges $175 for a 1MB RAM upgrade, while Standard charges $75, but their prices are closer (at $350 and $300, respectively) for a 4MB upgrade to the 5MB RAM limit. Both companies offer a one-year parts-and-labor warranty with mirror-shipping.

With a width and depth less than 11 by 8.5 inches, this system passes the "sheet-of-paper footprint" test. It weighs in at a shade over 6.5 pounds with the battery. An AC adapter adds another pound.

Each notebook has a VGA port that lets you use an external monitor instead of the Sharp supertwist LCD VGA screen with its CCFT (cold-cathode fluorescent tube) backlight. Unlike some portables that can produce only VGA (600 by 480), this notebook optionally outputs Super

FACT FILE

Fora NBS-386S/20
Fora Inc., 3096 Orchard Dr., San Jose, CA 95134; 800-367-3672, 408-944-0393.
List Price: $1,975.
Tested Configuration: 2MB RAM, 40MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case.
Options: 60MB unit, $200. 1MB RAM upgrade, $175; 4MB RAM upgrade, $350; external floppy disk drive, $195; numeric keypad, $135; extra battery, $75; 2,400-bps modem with 4,800-bps send-only fax, $245.

CIRCLE 423 ON READER SERVICE CARD

Like the Standard SX/20 Notebook, the Fora NBS-386S/20 (right) can output Super VGA (800-by-600 resolution) on an external monitor.

BATTERY RUNDOWN TESTS: INEXPENSIVE NOTEBOOKS

The best battery life comes from a 286 with a 1.9-pound battery. The NoteStar NP-902, from MicroStar Computers, lasted a remarkable 4 hours 32 minutes. This system's dual battery also made the NoteStar NP-902 (along with its 386SX/16 sibling, the higher-powered but shorter-lived NoteStar NP-903) one of the heaviest systems in our review.

WHAT THE NUMBERS MEAN

With battery lives of 4.5 and 3 hours, respectively, the MicroStar NoteStar NP-902 (a 286/12) and NoteStar NP-903 (a 386SX/16) outlasted the other systems we reviewed, which were 386SX/20s. Consistent with our past findings that heavier batteries yield longer life, these dual-battery NoteStar units also have 1.9-pound battery complements, the heaviest in the group.

The 1.5-hour difference in Battery Rundown test scores between the two NoteStar versions was also consistent with our finding that systems with slower processors have a longer battery life when the same-size battery is used: 286s beat 386SXs; 16-MHz systems tend to outlast 20-MHz ones.

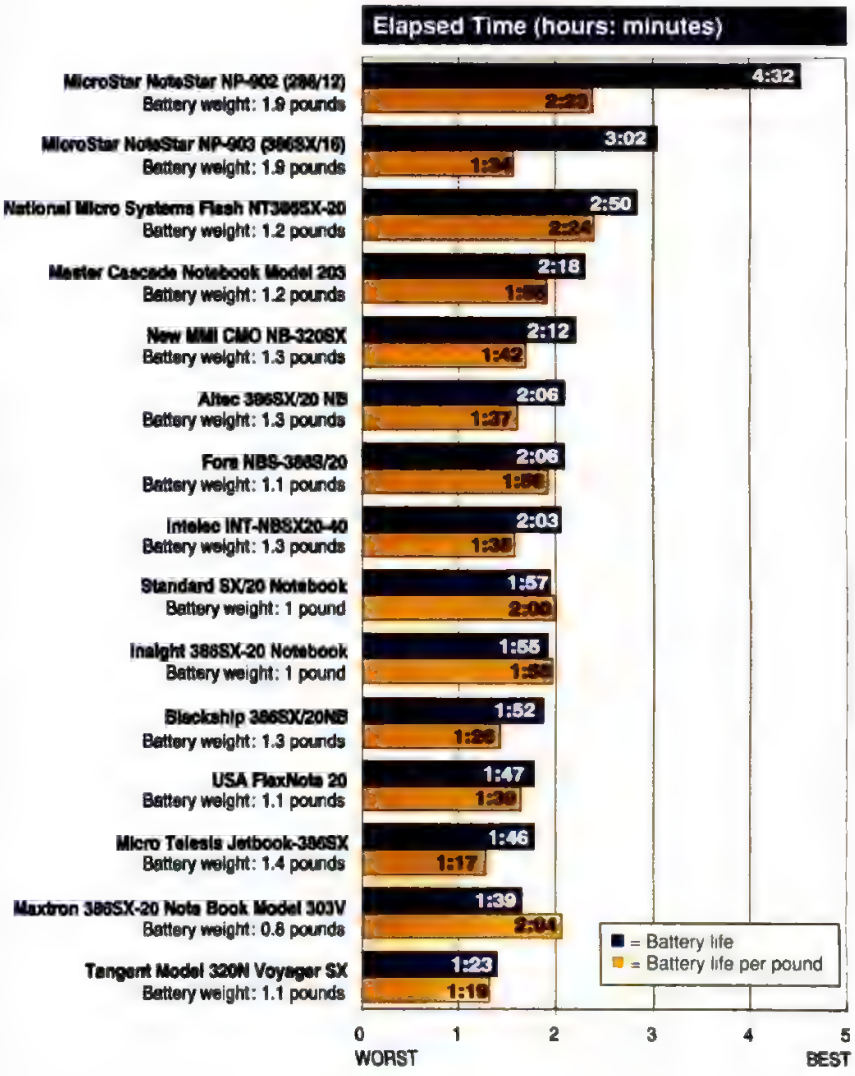
Among the 386SX/20 contenders, none lasted as long as 3 hours. The National Micro Systems Flash NT386SX-20 came closest, falling 10 minutes short; the Tangent Model 320N Voyager SX turned in the worst battery performance (1 hour 23 minutes).

When using the average battery life per pound as an indication of battery design and usage efficiency, we found that the average of 1 hour 47 minutes per pound is identical to the average of the 27 386SX notebooks we reviewed in our August 1991 issue. For the 20-MHz models, this parameter ranged from 1 hour 17 minutes per pound for the Micro Telesis Jetbook-386SX to 2 hours 24 minutes per pound for the National Micro Systems unit.

Among the four systems using an identical motherboard—the Altec, Blackship, Intelec, and New MMI—the battery life ranged from the Blackship 386SX/20NB's 1 hour 52 minutes to the New MMI CMO NB-320SX's 2 hours 12 minutes. The New MMI and the Altec 386SX-20 NB, featuring the same VLSI chip set version and a Sharp display, turned in battery lives within 6 minutes of each other. The Intelec INT-NBSX20-40, with the same version of the VLSI chip set and an Epson display, fell in the same ballpark (2 hours 3 minutes). The Blackship system ran out of steam 11 minutes sooner than the Intelec notebook. A different version of the VLSI chip set in the Blackship portable may have been the culprit.

HOW WE TESTED

To measure battery life for the reviewed notebooks, PC Magazine Labs depleted the batteries fully and recharged them according to each manufacturer's instructions. We performed PC Labs' Battery Rundown test with all power conservation features disabled, the modem (if installed) turned off, and the brightness set somewhere in the middle of the screen's range to simulate comfortable viewing. The **Battery Rundown** test involves teletyping five screens of text to the laptop computer's display and writing a 15K file to the hard disk, once every minute until the battery runs out of power.



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And now the value is greater than ever: with a suggested list price of only $399(U.S.) for the complete package, the 180si printer is a sensational buy! For more information and the name of a dealer near you in the U.S. and Canada, call 1 800 344-0006.*

**Manufacturer's suggested list price. Dealer prices may vary.*

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KODAK *New Kodak Diconix 180si printer*

CIRCLE 196 ON READER SERVICE CARD

VGA (800 by 600). This system also comes with high-resolution drivers for various applications, including Microsoft Windows 3.0.

Since there is only one serial port and no mouse port, you have to put the mouse on the serial port and use the proprietary internal fax modem. Unfortunately, that modem (about $200 from either company) won't give you error correction, so it may not suit your needs.

Though there is no expansion unit port, you can put an external 1.2MB floppy disk drive on the parallel port. Only Fora, however, offers an external floppy disk drive.

The nickel cadmium battery pack ran for about 2 hours on our Battery Rundown test; you should be able to get at least that much from a single charge. Though you can swap the battery packs quickly, you have to turn the computer off first—even if you are connected to AC power at the time.

The computer comes with a useful manual that has plenty of illustrations and instructions on how to set it up. Power-saving features let you power-down the hard disk, turn off the LCD backlight, and turn off different ports. Other benefits include a password in ROM and space for an internal fax/modem. The AC adapter automatically adjusts to different power sources, from 90 to 264 volts. The case has an attractive textured finish that looks destined to wear well, while making it easier to keep a firm grip.

There are plenty of points on the downside of the ledger, though. For instance, the hatches that cover the ports on each side are flimsy and rely on a careful fit between the top and bottom halves of the case to stay closed. One of the two machines had a hatch that kept flopping open, despite all efforts to close it securely. A notebook with hatch covers that flop open will rapidly become a notebook with no hatch covers.

As with most 8.5- by 11-inch computers, the keyboard is somewhat compromised. Though the cursor keys form an inverted T at the lower right—a configuration that many users prefer—they double as PgUp, PgDn, Home, and End, relying on a separate Fn key to activate their dual roles. All the keys on the top row—including the function keys, Esc, Ins, and Del—are half-size, hence extremely difficult to find reliably with a groping pinky. The Enter key is much smaller than usual; even worse, the Backslash key sits squarely where you would expect to find Enter. Since many other keys also serve multiple functions, the result is a visually cramped and cluttered keyboard.

Key arrangement can be dismissed in part as a matter of taste. Some of the keys, however, tended to stick, especially the half-size ones on the top row. A Delete key that sticks and eats up a paragraph or two of your prose might become unpopular in a big hurry. All of these problems go away when you plug a full-size keyboard into the keyboard port.

The VGA display circuitry showed some compatibility problems, the most significant of which was an inability to handle a VGA programmable character set correctly.

If the Fora NBS-386S/20 and Standard SX/20 Notebook had no competition, they would be small miracles, though they're actually competing in a crowded field. You may find the compromises are worth the money.

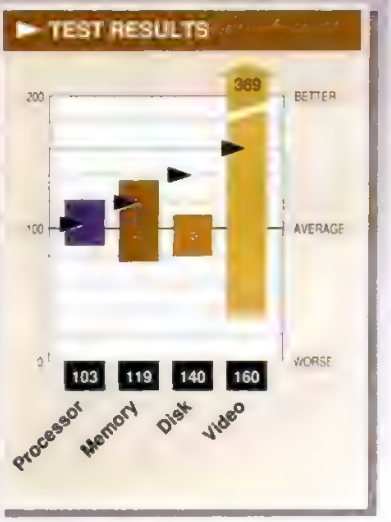
FACT FILE

Standard SX/20 Notebook
Standard Computer Corp., 12803 Schabarum Ave., Irwindale, CA 91706; 800-662-6111, 818-337-7711.
List Price: $1,995.
Tested Configuration: 2MB RAM, 40MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case.
Options: 60MB unit, $200. 1MB RAM upgrade, $75; 4MB RAM upgrade, $300; 80387SX coprocessor, $185; extra battery, $99; 2,400-bps modem with 4,800-bps send-only fax, $199.

CIRCLE 545 ON READER SERVICE CARD

Standard SX/20 Notebook

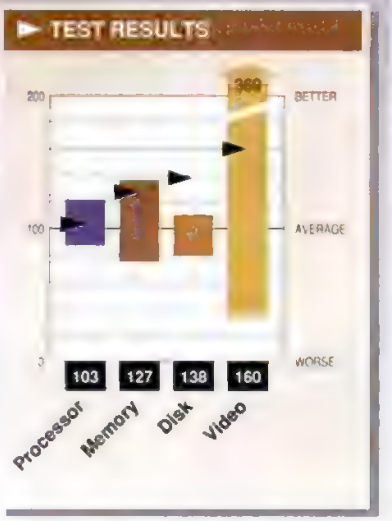
Battery Life: 1 hour 57 minutes.



In Short: The Standard SX/20 Notebook weighs just over 6.5 pounds, has a 60MB hard disk option, and can support Super VGA–resolution displays through an external video port. It is the same as the Fora notebook, however, and suffers from a limited battery life, expansion constraints, and a less-than-optimal keyboard design. Most users will find better choices elsewhere.

Fora NBS-386S/20

Battery Life: 2 hours 6 minutes.



In Short: The $1,975 Fora NBS-386S/20 is identical to the Standard SX/20 Notebook. There is no compelling reason to pick one over the other, except a $20 savings over the Standard model. Each has Super VGA support for an external monitor, offers a 60MB hard disk and a plain-vanilla 2,400-bps modem, and weighs just over 6.5 pounds. Keyboard limitations, an average battery life, and limited expansion capabilities reduce its appeal.

INSIGHT COMPUTERS

Insight 386SX-20 Notebook

BY JOHN R. QUAIN With its flat-black finish, the 7.2-pound Insight 386SX-20 Notebook makes an attractive traveling companion, although slightly heavier than

WE HAVE A FEW WORDS FOR PEOPLE WHO DEMAND HIGH PERFORMANCE AND EXPECT TO PAY PEANUTS FOR IT.

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MORE POWER TO YOU.

You wanted it, you got it.

Introducing the Dell® 486P/20. A computer that gives you an i486™ SX processor at the price of an i386™ DX machine.

An incredible performance boost of up to 40% at virtually no additional cost.

Generating enough processing power to exploit the full potential of future versions of Microsoft® Windows™ and OS/2®.

Making whatever software you run, run that much faster.

Giving you quicker recalcs, database compiles and screen refreshes.

In short, getting rid of excess wait.

And if that isn't impressive enough, the Dell 486P/20 comes with an upgradeable processor that can go from a 20 MHz i486SX chip all the way up to a high-end 33 MHz i486DX system, and even beyond.

Which, considering that we're talking about a computer under $2,000, is nothing short of revolutionary.

A true power user's desktop. For its low price, the Dell 486P/20 has a lot of technical innovations you wouldn't expect to find on even higher end machines. Things like programmable Flash EPROMs, for example, that make conventional methods of upgrading system BIOS seem almost obsolete. You won't have to take this computer apart and lose your patience trying to pry out a reluctant chip. Just slip in a diskette—that's all.

Expanding memory is equally convenient. One of the few PCs to support 16 MB SIMMs, the 486P/20 carries 4 memory expansion sockets, on its main board. So as your needs grow, you can keep adding RAM in 1, 4, or 16 MB increments up to a total of 64 MB. That's plenty of room to run your networking software, Microsoft Windows and just about any high-performance graphics application.

And talking about graphics, a small expansion of video memory to 1 MB (512K is standard) will put over *32,000 colors* at your disposal, letting you create images that approach photographic quality.

The 486P/20 also makes those images a lot easier on your eyes. It supports up to 1024 x 768 non-interlaced video at a fast 70 Hz refresh rate for a flicker-free display. Unlike the kind you get on some competitive machines that are limited to 60 Hz non-interlaced.

An i486SX processor with the future built in. Because the Dell 486P/20 upgrades via a processor chip instead of traditional processor cards, upgrading takes the form of a single, economical step:

Just remove one chip and replace it with a higher performance version.

On the other hand, if you never need to upgrade at all, you don't end up having paid a price penalty to get the system in the first place. Either way, you win.

Apart from the processor, the 486P/20 is also designed to allow easy upgrading of hard disks, memory and video capability. So when your needs change, the rest of your computer can, too.

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THE DELL 486P/20 20 MHz i486SX SYSTEM.*

SYSTEM INCLUDES 50 MB HARD DRIVE, VGA COLOR MONITOR, AND 2 MB RAM.

HE MORE YOU SAVE.

e've just mentioned, here's an amazing fact: feature for feature, you can get an
our savings increase with the sophistication of the Dell System* you buy. So go ahead, read on.
now the more our i486 systems cost, the less they actually cost.

MORE SPEED

From desktop publishing to spreadsheet applications, there's one feature that's always welcome, and that's speed. With quick recalcs and lightning fast screen refreshes, you'll get your work done faster with the Dell 486P/33.

The 33MHz i486DX processor generates up to 80% more performance than 33MHz i386DX systems. If that leaves you craving for more, you can upgrade to a faster i486 processor when available.

This 486P/33 configuration features a 100 MB hard drive with a phenomenal 15 ms average access time. An 8 KB cache in the processor boosts performance. And dual floppy drives allow you to read any diskette, regardless of MS-DOS format.

A 1024 x 768 non-interlaced big 15" color monitor with overscan gives you 30% more viewable area than the standard 14" you get with any competitively priced system. For even more versatility on desktop publishing or graphic-intensive applications, just expand video RAM to 1 MB and you'll get a 32,000 color, near-photograph quality display.

The system comes with 4 MB RAM on 32-bit SIMMs with gold-plated connectors, MS-DOS 5.0, Microsoft Windows 3.0 and a Microsoft Mouse.

THE DELL 486P/33 33 MHz i486DX SYSTEM.*
SYSTEM INCLUDES 100 MB HARD DRIVE, ULTRASCAN 15C MONITOR, 5.25"1.2 MB AND 3.5"1.44 MB FLOPPY DRIVES AND 4 MB RAM.

SAVE $948▽

MORE GRAPHICS

The Dell 486D/33 has every high-end feature you'd expect in an outstanding graphics workstation. Except a high-end price tag.

There's a superfast 33 MHz i486DX processor, with 8 KB internal cache. For even greater performance, all you'll need to do is replace a processor chip. So you can upgrade inexpensively as soon as new chips hit the market.

Should your workload, heaven forbid, triple by then, you'll still find the 200 MB hard disk more than adequate.

And as your requirements become increasingly more sophisticated, you can keep adding to the 486D/33's 8 MB RAM. With a maximum of 64 MB, there's plenty of room to grow.

Talking about room, we have a large 15" flat square monitor with 30% more viewable area than a standard 14" monitor, which makes those large spreadsheets and high resolution documents much easier to read.

The Dell 486D/33 comes with factory-loaded MS-DOS 5.0, Microsoft Windows 3.0 and a Microsoft Mouse.

intel inside

THE DELL 486D/33 33 MHz i486DX SYSTEM.*
SYSTEM INCLUDES 200 MB HARD DRIVE, ULTRASCAN (1024 x 768) 15C MONITOR, 5.25"1.2 MB and 3.5"1.44 MB FLOPPY DRIVES AND 8 MB RAM.

SAVE $1,348▽

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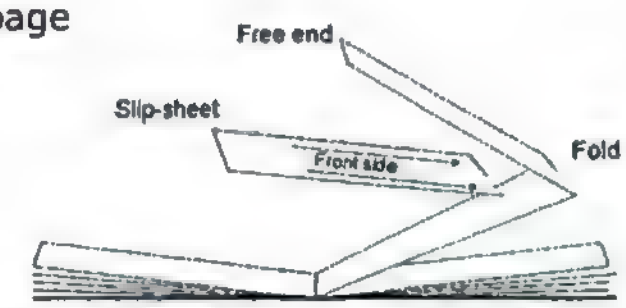
GbsSlipSheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

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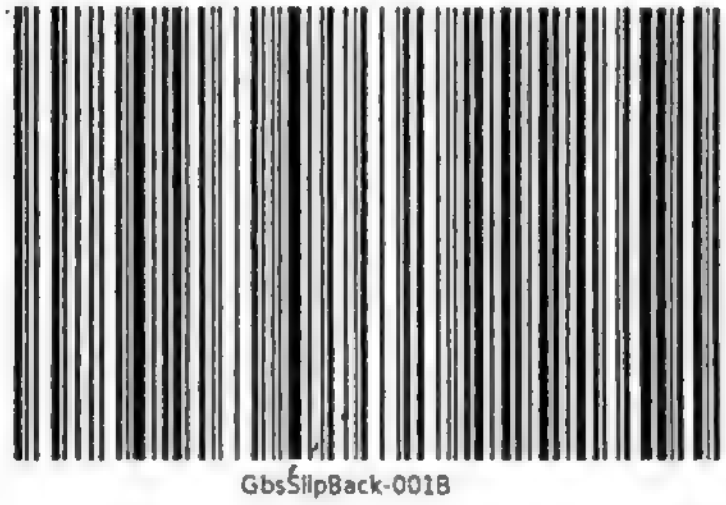
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

THE MORE YOU GET, T

If your requirements call for a more powerful or specialized system than the one w
even better deal with our higher-end i486 systems. From $248 all the way up to a whopping $1,348, y
And if you still have any doubts, call us. We'll be happy to explain

MORE VALUE

The Dell 486P/20 is a 20 MHz i486SX general purpose workstation you can upgrade to 33 MHz and beyond.

For a configuration that costs so little, you sure get a lot.

Like programmable Flash EPROMs for easy BIOS upgradeability.

And an 80 MB hard disk drive with 15 ms access time.

And an 8 KB cache built into the processor for increased throughput.

And 4 MB of RAM on 32-bit SIMMs with gold-plated connectors for greater reliability.

And 2 floppy drives.

Surprised? Keep reading.

You'll also get a 1024 x 768 14" color monitor with long persistence phosphors.

And the power to display 32,000 colors simultaneously, if you expand video memory to 1 MB.

And factory-installed MS-DOS® 5.0 and Microsoft Windows 3.0.

And a Microsoft Mouse.

And, considering it's from Dell, a whole lot of peace of mind.

That, by itself, is worth a fortune.

THE DELL 486P/20 20 MHz i486SX SYSTEM.°

SYSTEM INCLUDES 80 MB HARD DRIVE, SUPER VGA (1024 x 768) COLOR MONITOR, 5.25"1.2 MB AND 3.5"1.44 MB FLOPPY DRIVES AND 4 MB RAM.

SAVE $248▽

MORE PRODUCTIVITY

The Dell 486D/25 is a sophisticated productivity workstation that was designed with your future in mind. To upgrade from a 25 MHz i486SX processor to a faster processor when available, all you'll need to do is replace a processor chip. Not a card. And starting with 4 MB, you can keep adding RAM up to a maximum of 64 MB.

This new system is priced on par with 33 MHz i386DX machines, yet performs up to 40% faster. And its sheer processing power is amply backed by a 100 MB hard drive with a 32 KB cache for increased throughput. A dual floppy drive completes the excellent storage arrangement.

A 1024 x 768 14" color monitor with a 70 Hz refresh rate gives you a flicker-free display. With 32,000 colors, if you make a small expansion of video RAM. Should anything go wrong, the built-in SmartVu™ diagnostic display can find the problem, even if the monitor goes down.

The 486D/25 comes with six expansion slots and five drive bays for added flexibility. You'll also get factory-loaded MS-DOS 5.0, Microsoft Windows 3.0 and a Microsoft Mouse.

THE DELL 486D/25 25 MHz i486SX SYSTEM.°

SYSTEM INCLUDES 100 MB HARD DRIVE, ULTRASCAN™ 14C MONITOR, 5.25"1.2 MB AND 3.5"1.44 MB FLOPPY DRIVES AND 4 MB RAM

SAVE $748▽

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Gold-plated SIMMs increase system reliability by eliminating connection-related errors.

There are plenty of companies anxious to sell i486 systems at a low price. All they really need is a supply of parts (the cheaper, the better) and a garage to assemble them in. Once the "production line" gets going, they place a few ads in the paper. After that, of course, it's anyone's guess as to which will last longer: the computer or the "company" it came from.

The 486P/20 is one of the few computers to feature 16 MB SIMMs.

At Dell, on the other hand, we offer lower prices by cutting down on traditional retailer mark-ups, not quality. In fact, we're almost fanatical about the quality of every machine that leaves our state-of-the-art factory. That attitude is reflected in the way we design, test, manufacture and ship our i486 systems.

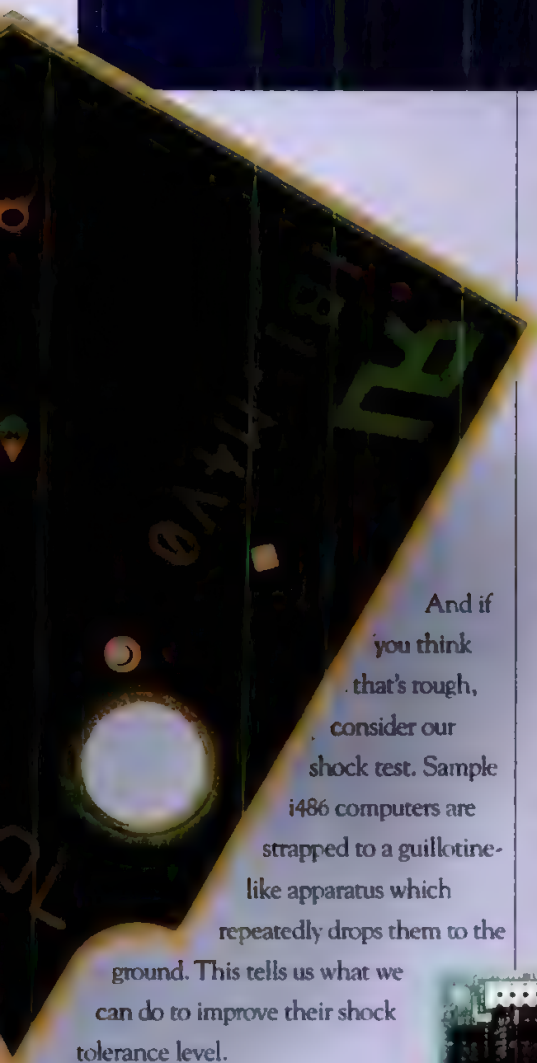
To see how our i486 systems stand up to air delivery, we use a Black Box. Or, in technical parlance, a portable accelerometer/thermometer. This little device is fitted into a test computer which we then send out through regular delivery channels, much as if you had ordered it yourself. When we bring it back, the "Black Box" tells us exactly what the computer went through, in terms of shock, vibration and temperature. This innovative test is part of a series that's been so successful in helping us improve our packaging, we've won an international award for package design.

Our Black Box test makes sure your Dell computer never arrives this way.

To make our computers more reliable, we cook them. After our computers are fully assembled and configured, randomly selected units are "burned-in" and tested at 104°F.

In perhaps the most grueling temperature test we've ever come up with, pilot Dell systems must survive a storage chamber where temperatures vary rapidly between −40°C and +60°C.

JUST BECAUSE YOU PAY LESS DOESN'T MEAN YOU GET LESS.



And if you think that's rough, consider our shock test. Sample i486 computers are strapped to a guillotine-like apparatus which repeatedly drops them to the ground. This tells us what we can do to improve their shock tolerance level.

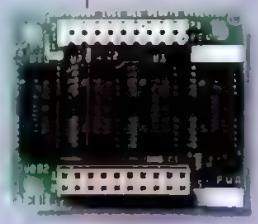
Our power supply units undergo an equally rigorous quality control process. In a test that simulates several years of actual usage, randomly selected test units are switched on and off *1,200 times;* only then can they be approved.

While our testing may seem a little extreme, it's based on a rather simple fact: if our machines don't fail with us, they haven't much chance of failing with you, either.

Our computers have a heart of gold. At Dell, we take quality consciousness so seriously, we fit our i486 systems with SIMMs that have gold-plated connectors. If you're wondering what such expensive components are doing in relatively inexpensive computers, the answer is simple: they cost us a bit more, but by eliminating connection-related errors, they're worth their weight in gold.

It's exactly this kind of commitment to quality control that's enabled us to meet CSA, UL, TUV-GS, FCC and VDE standards, earning worldwide regulatory approvals.

There are thousands of ways to use a Dell i486 system. Dell i486 systems are tested for compatibility with major peripherals, software applications, network topologies and network operating systems, including Banyan and Novell, in several hundred permutations per system. They're even tested for AS-400 connectivity. So you can use our machines in virtually any environment.



A small expansion of video memory gives you over 32,000 colors for a near photographic quality display

50% fewer opportunities for things to go wrong. After the traditional computer manufacturer builds a system, it goes to the dealer, who then does his own configuring. That's 2 stages of manufacturing, which means twice as many opportunities for things to go wrong.

Random Dell computers are "burnt in" at 104 degrees Fahrenheit.

A Dell i486 system, on the other hand, is manufactured only once. We custom-configure memory boards, network cards and advanced video, testing the system as a unit.

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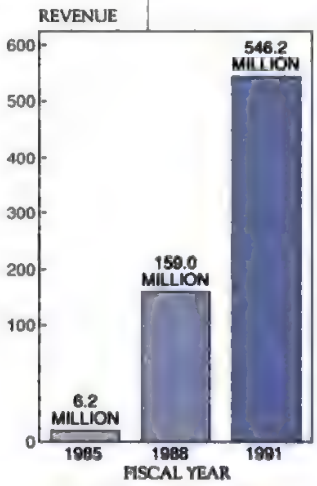

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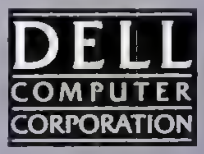

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#11BQ9

FACT FILE

Insight 386SX-20 Notebook
Insight Computers, 1912 W. Fifth St., Tempe, AZ 85281; 800-776-7600, 602-350-1176.
List Price: $1,995.
Tested Configuration: 2MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, mouse, AC power adapter, carrying case.
Options: 20MB unit, $1,695. 4MB RAM upgrade, $299; external floppy disk drive, $169; external keyboard, $75; numeric keypad, $49; extra battery, $79; 2,400-bps modem, $99.

CIRCLE 424 ON READER SERVICE CARD

average. Once you get past the cosmetics, though, you will find that this 2.1- by 11.3- by 8.3-inch notebook falls short. On PC Magazine Labs' tests, the $1,995 386SX-20 Notebook turned in rather poor video performance, and inside it revealed sparse accommodations—no room for an internal modem and no external expansion bus—though it can handle plenty of peripherals.

The 20-MHz 386SX notebook from Insight Computers comes with 2MB of 80-nanosecond DRAM, a 60MB hard disk, DOS 5.0, a three-button Insight mouse, and a dual-voltage power adapter. The system is based on a Chicony motherboard and VLSI chip set, a combination that encouraged excellent processor performance. An AMI BIOS makes it all work in concert and contains a setup menu that allows security-conscious travelers to specify password protection, as well as set the requisite video and BIOS shadowing options.

An additional setup utility lets you put the screen, the hard disk, or both to sleep after 1 to 9 minutes of inactivity. The CPU follows suit by slowing to 3 MHz. If you're inattentive, the notebook sounds an alarm to remind you to change the battery. On our Battery Rundown test with the power conservation options disabled, the 386SX-20 Notebook lasted 1 hour 55 minutes—middling performance for this class of notebooks.

Recharging the battery takes 2 hours with the notebook turned off and 4 hours while it is in use—relatively quick charge times. This benefit is offset, however, by the lack of an available battery charger. Those who need more than a couple of hours of traveling computing time will have to charge extra batteries in the PC ($79 each).

Insight offers three hard disk options: 20MB ($300 off the system price), 60MB, or 80MB (the price of the 80MB drive was unavailable). To meet *PC Magazine*'s configuration requirement of a 40MB or larger hard disk, the company installed a 60MB Conner CP-2064. On our disk test, the larger hard disk didn't give the notebook any particular edge over those with a 40MB unit, but it didn't significantly hurt performance, and the extra 20MB is surely welcome.

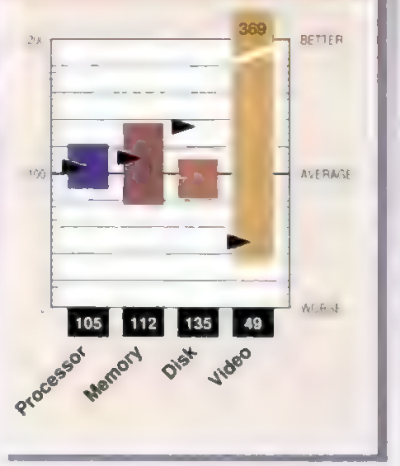
Flip up the dual-hinged screen and you will notice that the Sanyo backlit LCD screen is slightly larger than run-of-the-mill notebook screens: 7.6 inches wide and 5.8 inches high. That's 9.4 inches measured diagonally, but unfortunately its size is not equaled by its image quality. The system uses an 8-bit Cirrus Logic VGA chip set, which means that it badly trailed notebooks using 16-bit video, putting in the second-slowest time on PC Labs' video test. Furthermore, graphics applications like Microsoft Windows 3.0 (a $49 option) produced some streaky results: not enough to make Windows unintelligible, but just enough to make the

A Chicony motherboard, VLSI chip set, and AMI BIOS helped the Insight 386SX-20 Notebook produce excellent processor performance.

Insight 386SX-20 Notebook

Battery Life: 1 hour 55 minutes.

TEST RESULTS



In Short: Despite its above-average processor, memory, and disk results, the Insight 386SX-20 Notebook is mostly distinguished by its lack of important options. Though the under-$2,000 price includes a larger-than-average 60MB hard disk, this notebook's inability to accommodate an internal modem and its slow video performance mean that the 386SX-20 Notebook is not quite up to the state of the art—at any price.

display quality annoying to the user.

Flip down the 386SX-20 Notebook's back panel and you will find accommodation for an external VGA monitor. The chip set won't run both displays simultaneously, but the connection means you won't always have to endure the poor visibility. Also on the back panel are ports for a printer, an external floppy disk drive (a $169 option), two serial devices, and an external keyboard ($75) or numeric keypad ($49). The 386SX-20 Notebook's regular 83-key keyboard is the dull, clicking type with little key action. The cursor keys, arranged in an inverted T shape, are separate from the Home, End, PgUp, and PgDn keys, but there are only 10 function keys rather than 12.

Three convenient slide-out panels on the underside of the notebook reveal the battery compartment, plus room for a math coprocessor and memory expansion. If you want to add to the 2MB of RAM—which performed well on our memory test—you will have to discard a 1MB module to add the 4MB option ($299).

Insight does a solid job packaging the Insight 386SX-20 Notebook with all the necessary cables, an easy-to-follow user manual, a one-year warranty, and toll-free technical assistance available seven days a week. In addition, the company set a new price—$1,795—after our review deadline. But if you have to tote an external modem, too, you may feel it's too much to squeeze into a briefcase.

MASTER COMPUTER INC.

Cascade Notebook Model 203

BY BRUCE BROWN Master Computer's Cascade Notebook Model 203 is the heaviest and largest notebook in this group. A good screen and keyboard, however, as well as a reasonable price tag of $1,895 almost make up for its size. Although plagued by the slowness of its 8-bit video chip, the Cascade is otherwise a fine if not overly speedy performer.

The Cascade Notebook Model 203 is manufactured for Master Computer by a Taiwan-based company aptly named Notebook Computer. Its price gets you the *PC Magazine* configuration of 2MB of RAM, a 40MB hard disk, DOS 5.0, utilities including a memory manager, a nickel cadmium battery, an AC/DC adapter, and a carrying case.

The system's case seems sturdy enough. A single door on the back folds down via a sturdy hinge to reveal a complement of five ports: one parallel, two serial, one VGA, and a port specifically designed for a 1.2MB floppy disk drive. The external disk drive itself is a $215 option.

You can upgrade memory yourself from 2MB to the system maximum of 5MB, but the DIP chips are on the high side: $325 per megabyte, available from Master Computer. There is no provision for an internal modem, but at least there are two serial ports, so you can run an external modem and a mouse at the same time.

The Cascade's 5- by 6.8-inch screen, made by Sharp, looks fine running Microsoft Windows 3.0 or other graphical interface programs. Contrast and brightness dials are on the left of the screen. The major drawback of this computer's video setup—its slow time on our video test—occurred as a result of the 8-bit Cirrus Logic video circuitry.

Tipping the scales at 7.8 pounds with the standard dual batteries attached, the Cascade isn't light. A pair of spare batteries, an AC adapter (2.2 by 6.5 by 3 inches), and the standard case bring the total weight to 12.1 pounds—not really bad, but more than that of many other units reviewed here.

The Cascade's 2- by 12- by 10.5-inch dimensions make it the bulkiest system in the group as well. Master Computer, however, manages to extract an advantage from that extra half-inch when it comes to keyboard design. There's a lot to like about the Cascade's 82-key keyboard. Features include an inverted-T cursor arrangement, separate (unshifted) Home, End, PgUp, and PgDn keys, and ten full-size function keys across the top. Key placement is good as well: The Fn key (which activates the embedded numeric keypad) and the F11 and F12 keys are located on the lower left of the keyboard; Ins and Del are on the lower right.

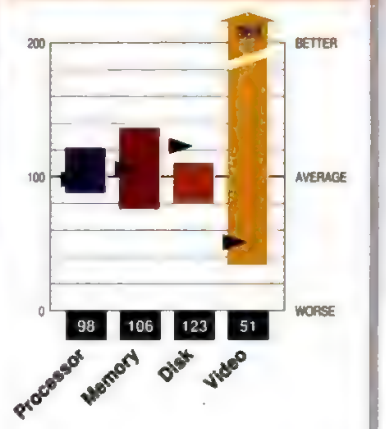
Each of the two batteries slides into a separate slot on the top rear of the machine. Battery life is rated at 2 to 3 hours, depending on usage, and the Cascade ran for 2 hours 18 minutes on our Battery Rundown test. Recharge time is 2 hours whether or not the computer is running. The only power conservation measures available are display and hard disk shutdown. Each can be set to varying intervals of inactivity and activated via a device-driver file.

There is no standard or optional on-site service available from Master Computer. The standard one-year warranty can be extended by another year for $150. All service problems that you can't resolve over the phone (9:00 to 6:00 P.S.T. week-

Master Cascade Notebook Model 203

Battery Life: 2 hours 18 minutes.

TEST RESULTS



In Short: At 7.8 pounds and dimensions of 12 by 10.5 inches, the Master Computer Cascade Notebook Model 203 is a bit bigger and heavier than average, but that's not the whole story. The better-than-average keyboard and screen and lower-than-average $1,859 *PC Magazine*-configuration price make it worth consideration.

FACT FILE

Cascade Notebook Model 203
Master Computer Inc., 10742 Fifth Ave. NE, Seattle, WA 98125, 206-365-1156.
List Price: $1,859.
Tested Configuration: 2MB RAM, 40MB JVC hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case.
Options: 60MB unit, $136. 2MB RAM upgrade, $325; external floppy disk drive, $215; 80387SX coprocessor, $150; numeric keypad, $95; extra battery, $125; car battery adapter, $59, 2,400-bps modem, $125.

CIRCLE 426 ON READER SERVICE CARD

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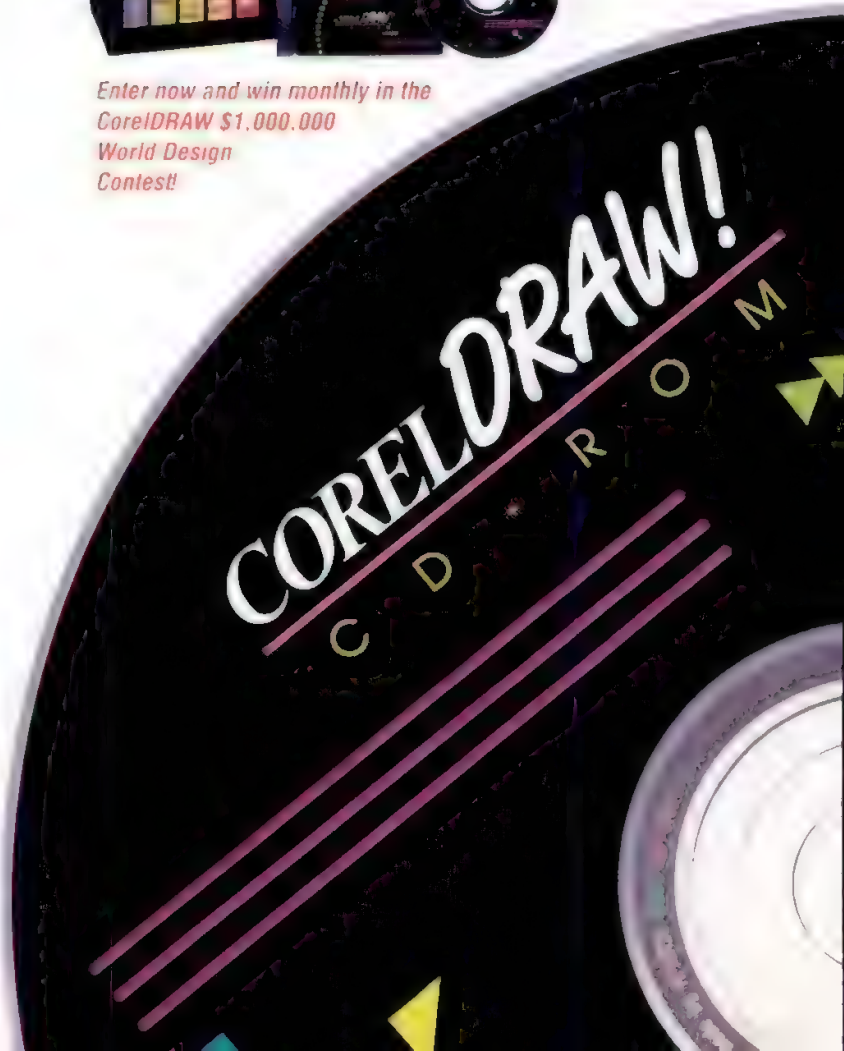

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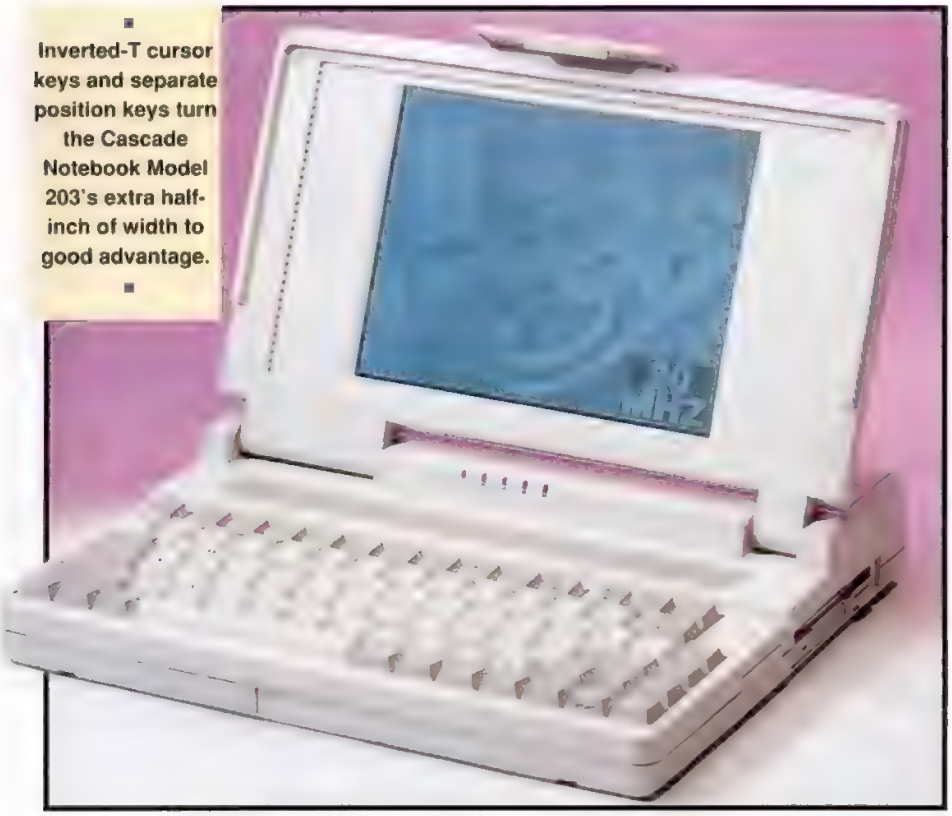


Inverted-T cursor keys and separate position keys turn the Cascade Notebook Model 203's extra half-inch of width to good advantage.

days; you pay for the call) are handled by sending the computer back to the vendor. Master Computer pays for the return shipping.

The Cascade Notebook Model 203 is unexceptional. The screen is acceptable (though slow), as are the keyboard and the selection of ports. Its battery time is adequate. You can even get a 60MB unit for $1,995 (Master Computer recently reduced the price). The only arguments against this notebook are its marginally large size and relatively heavy weight.

MAXTRON

Maxtron 386SX-20 Note Book Model 303V

BY TOM UNGER For those of you concerned about what a bargain notebook costs in terms of performance and features, Maxtron's $1,945 offering is an excellent case in point.

Your two grand will buy the spiffy-looking 386SX-based Maxtron 386SX-20 Note Book Model 303V, which weighs 6.5 pounds and measures 2.3 by 8.5 by 11.5 inches. This 20-MHz laptop has a bright, readable VGA LCD screen. You will also get a speedy 60MB Conner hard disk and a free carrying case. The same machine with a 40MB hard disk sells for $1,795, and for $200, you can boost this laptop's standard 2MB of RAM to a maximum of 4MB. A business traveler's dream, you say? Not quite.

The Note Book is manufactured in Taiwan by Brotherbox. The same unit is marketed as well by Broadax (not present in this roundup because the company failed to submit a system by our deadline), and it is as notable for what it lacks as for what it includes.

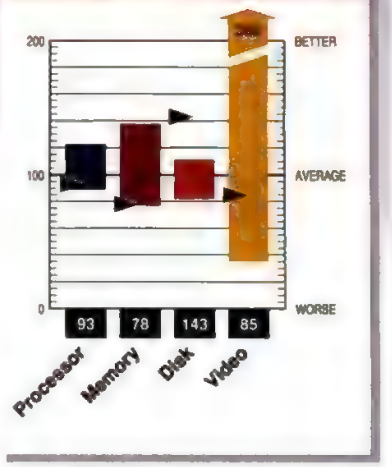
FEW BRIGHT SPOTS

Perhaps most notable is its lack of performance. This Maxtron unit came in last on PC Magazine Labs' processor and memory tests and scored second to last on the video test. In a class of machines designed for business travelers who run processor- and memory-dependent programs such as Microsoft Windows 3.0, the Maxtron may disappoint you. And because it uses an 8-bit implementation of the new Cirrus Logic video chip set (instead of using the chip set's 16-bit capability), the Note Book's video score suffered as well. It does, however, handle simultaneous displays.

Maxtron 386SX-20 Note Book Model 303V

Battery Life: 1 hour 39 minutes.

TEST RESULTS



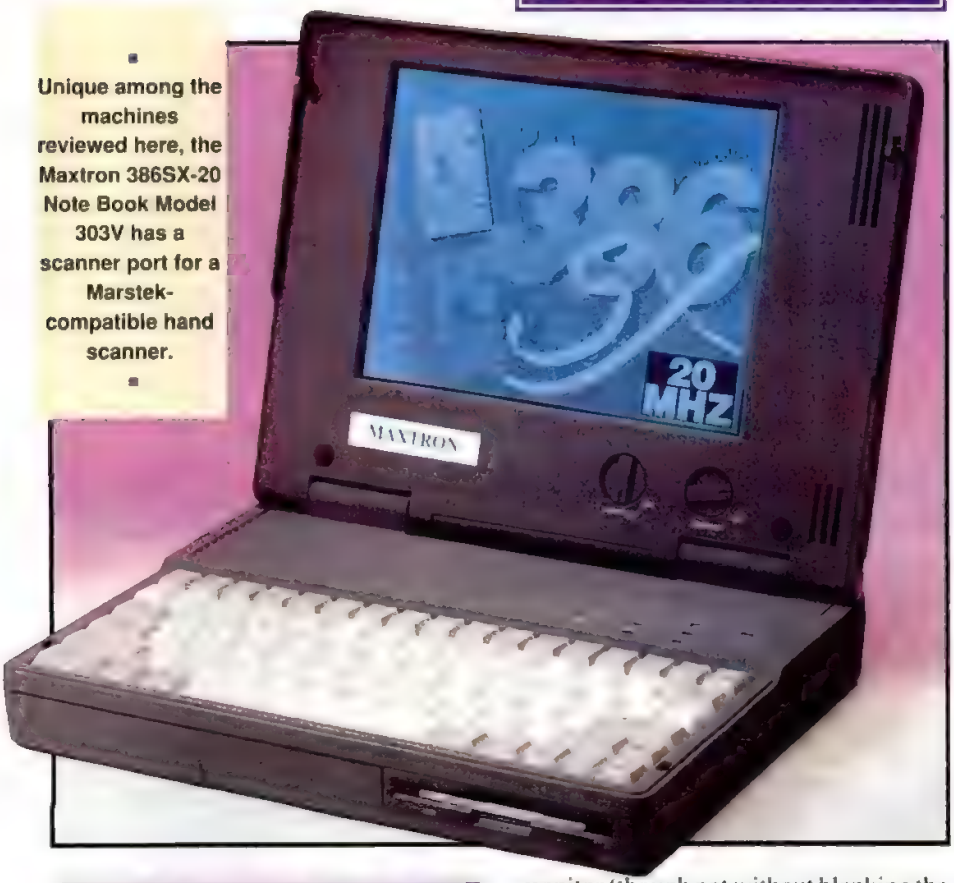
In Short: The Maxtron's processor and memory scores proved the slowest in our round up.The video score was disappointing, and the Battery Rundown time of 1 hour 39 minutes was second-slowest. To its credit, Maxtron's 386SX notebook does sport a Conner 60MB hard disk, PS/2-style mouse and keyboard ports, and a hand-scanner port. Nevertheless, its cursor keys come in the L-shape configuration—an annoyance for heavy typists. Also, you will have to lug an external modem.

The brightest spot here is its hard disk performance. Conner hard disks have generally scored well on our benchmark tests; here, true to form, the Conner 60MB hard disk in our test unit fared significantly better than most of the competition.

The Note Book's battery gave up after less than 1 hour 40 minutes. If you're not near an AC outlet long enough to recharge the unit, you will need another $100 0.8-pound battery to complete the trip. The standard battery included in our test machine had no pull-tab attached, however, so it cost us time and fingernails to remove it and insert the 1.2-pound, heavy-duty battery that Maxtron sells as a $50 option. The heavy-duty battery should lengthen the time by about 30 percent, according to the vendor. Activating the usual retinue of screen, disk, processor, and peripheral shutdown mechanisms will also add life to your laptop's travels.

Don't count on carrying much with your laptop if you use the free case supplied by Maxtron. Fitting around the machine like a second skin, this case will hold nothing other than a few floppy

LOOK WHAT PC MAGAZINE HAD TO SAY ABOUT A VERY GRAPHIC AND RACY SUBJECT.



Unique among the machines reviewed here, the Maxtron 386SX-20 Note Book Model 303V has a scanner port for a Marstek-compatible hand scanner.

FACT FILE

Maxtron 386SX-20 Note Book Model 303V
Maxtron, 1825A Durfee Ave. South, El Monte, CA 91733; 818-350-5707.
List Price: $1,945.
Tested Configuration: 2MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case.
Options: 40MB unit, $1,795. 2MB RAM upgrade, $200; 80387SX coprocessor, $250; numeric keypad, $100; extra battery, $110; car battery adapter, $75; ARCnet adapter, $280; Ethernet adapter, $350; 2,400-bps modem, $120.

CIRCLE 427 ON READER SERVICE CARD

disks and, if you're willing to risk a busted zipper, an extra battery. With an extra battery, the AC adapter, a pocket modem (the Note Book has no room for an internal modem), and the carrying case, you will be toting about 11.5 pounds of computer and peripherals.

Once you get to where you're going, the Note Book provides a parallel and a serial port, as well as some extra ports: one for a Marstek-compatible hand scanner, another for a PS/2-style mouse, a 101-key keyboard port, and a VGA port that will send a signal to a standalone monitor (though not without blanking the notebook's LCD screen).

Maxtron offers a variety of other options, including a 2,400-bps pocket modem with V.42bis error correction and data compression ($120), a send/receive pocket fax modem ($320), and ArcNET and Ethernet adapters ($280 and $350, respectively). Maxtron does not bundle any software with the system other than DR DOS.

Maxtron sells the Note Book Model 303V only through dealers and offers a one-year parts-and-labor warranty. Service policies and extended warranty options are determined by individual dealers. The company has no toll-free service or support lines, although a Maxtron representative will cheerfully answer your questions at your expense during regular business hours, five days a week, P.S.T.

The Maxtron 386SX-20 Note Book Model 303V may not have space for an internal modem, and its video may be slow, but its mouse and scanner ports are unusual for this group, and its simultaneous-display capability is a boon to mobile presenters. While it is a little heavy, at 11.5 pounds with extra gear, you may nevertheless find this mixed bag light on your wallet.

MICROSTAR COMPUTERS INC.

NoteStar NP-902
NoteStar NP-903

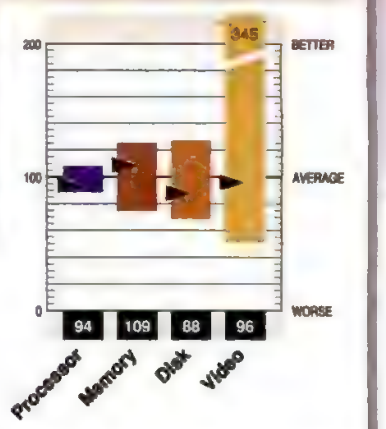
BY HENRY FERSKO-WEISS MicroStar Computers' two notebooks offer a novel and practical approach to expansion, just one element that stands out from their many fine features. Drawing on a variety of plug-in modules, they make selecting hardware accessories about as easy as putting a videocassette into a VCR. The biggest drawback of these two systems is processing power: The NP-902 has a 12-MHz 286 CPU, and the NP-903 comes with a 16-MHz 386SX chip.

The key to this scheme is the dual-battery design: a battery in each compartment. The modules go where the batteries go, so you must choose between having two batteries and having one battery and a module (or two modules on AC power). For example, you can clip a 9,600-/2,400-bps fax/modem module into one compartment and still get about 1.5 hours of battery life. Other modules include an

MicroStar NoteStar NP-902

Battery Life: 4 hours 32 minutes.

TEST RESULTS



In Short: Modular expansion, an especially long battery life, and a good VGA display make this 286/12 notebook attractive. At 12 by 9.5 inches, however, it's slightly larger than true notebooks and it weighs a bit more, at around 8 pounds. MicroStar pays for next-day air shipping both ways under warranty and guarantees a 48-hour turnaround. The 80MB hard disk, SCSI interface, and fax/modem options are well worth getting.

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PC Magazine
October 15, 1991

Pretty hot stuff, huh? And that's not all *PC Magazine* felt fit to print about our DECpc™ 433 Workstation. Just get a load of this: "The DECpc 433 adds value to the existing standard without sacrificing compatibility. What's more, this machine shows strength in an area where DEC knows a thing or two: the graphics workstation market."

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- 1 parallel, 2 serial ports
- External monitor and keyboard ports
- 6.5 lbs., 8.5" x 11" x 2.5"
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	Compudyne NBSX/16	ZEOS 386SX 16 Notebook	CompuAdd 316NX	Compudyne NBSX/20
CPU	Intel386SX 16 MHz	Intel386SX 16 MHz	Intel386SX 16 MHz	Intel386SX 20 MHz
Std. Memory	2 MB	1 MB	2 MB	2 MB
Max. Memory	16 MB	3 MB	6 MB	16 MB
CPU Cache	none	none	none	none
Hard Drive	40 MB IDE	20 MB IDE	30 MB IDE	60 MB IDE
I/O Ports	2 serial, 1 parallel monitor, keyboard	1 serial, 1 parallel monitor	1 serial, 1 parallel monitor, keyboard	2 serial, 1 parallel monitor, keyboard
Screen	9" 32 grey	10" 32 grey	10" 32 grey	9" 32 grey
Software	MS-DOS 5.0	none	MS-DOS 4.01	MS-DOS 5.0
Weight	6.5 lbs	7 lbs	6 lbs	6.5 lbs
Price	$1499	$1995	$1995	$1699

	ZEOS 386SX 20	Northgate 386SX 20	Compudyne NBSL/20	Zenith Mastersport 386SL
CPU	Intel386SX 20 MHz	Intel386SX 20 MHz	Intel386SL 20 MHz	Intel386SL 20 MHz
Std. Memory	1 MB	1 MB	2 MB	2 MB
Max. Memory	5 MB	5 MB	6 MB	8 MB
CPU Cache	none	none	64 K	64 K
Hard Drive	20 MB IDE	40 MB IDE	60 MB IDE	60 MB IDE
I/O Ports	1 serial, 1 parallel monitor	2 serial, 1 parallel monitor, keyboard	2 serial, 1 parallel monitor, keyboard	1 serial, 1 parallel monitor, keyboard
Screen	10" 32 grey	8.5" 32 grey	10" 64 grey	9" 32 grey
Software	none	MS-DOS 5.0	MS-DOS 5.0	MS-DOS 4.01
Weight	7 lbs	6.1 lbs	6.4 lbs	6.8 lbs
Price	$2295	$1799	$2199	$4999

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- 1 parallel, 2 serial ports
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CIRCLE 132 ON READER SERVICE CARD

FACT FILE

NoteStar NP-903
MicroStar Computers Inc., 35 Cotters Ln., #C-1, E. Brunswick, NJ 08816; 908-651-8686.
List Price: $2,190.
Tested Configuration: 2MB RAM, 60MB Western Digital hard disk, 1.44MB floppy disk drive, DOS 4.01, Microsoft Windows 3.0, AC power adapter, carrying case.
Options: 40MB unit, $1,977. 2MB RAM upgrade, $100; 4MB RAM upgrade, $200; external floppy disk drive with second serial port, $249; 80387SX coprocessor, $125; extra battery, $63; external battery charger, $189; car battery adapter, $24; ARCnet adapter, $139; Ethernet adapter, $179; SCSI adapter, $89; 2,400-bps modem, $168; 2,400-bps modem with MNP 5 data compression, $209.

CIRCLE 426 ON READER SERVICE CARD

ArcNET, Ethernet, or SCSI interface; an IBM 3270 emulation; and a choice of two other modems (one with MNP 5 error correction). MicroStar says it will soon add an expansion unit that accepts two full-size 8-bit boards. Combine these modules with an external keyboard and VGA monitor and your NoteStar notebook could be spending most of its life as a well-stocked desktop unit.

The NoteStar units are the heaviest systems in this bunch, but they have the best battery life by far. The NoteStar NP-902—the heavier of the two—weighs 8.2 pounds, and the NoteStar NP-903 8 pounds. With the combination adapter and charger, the cables, and the soft carrying case, these weights climb to about 11 pounds each. An especially heavy-duty plastic case and the 1.9-pound battery complement account for some of that weight. The notebooks are also slightly larger than average: 2 by 12 by 9.5 inches.

The 12-MHz NoteStar NP-902 is the only 286-based computer in this roundup—the only one submitted that met our street-price cutoff. It lists for $1,730 in the *PC Magazine* configuration (2MB of RAM, a 40MB hard disk, DOS 5.0, utilities including a memory manager, a nickel cadmium battery, an AC/DC adapter, and a carrying case). This translates to about $1,575 after a 15 percent street-price discount. The NoteStar NP-903, a 386SX/16, costs $2,077 ($1,870 street price) for the same configuration. With the tested 62MB hard disk, the NoteStar NP-903's price goes up to $2,190 (about $1,975 after a discount).

Apart from their peripheral expansion, you can easily increase these notebooks' memory in 1MB or 2MB increments, up to a maximum of 8MB. At $120 per 2MB, the cost is quite reasonable. Hard disks range from 20MB to 80MB, in 20MB increments.

While the two batteries add 1.9 pounds to each NoteStar portable's weight, they also provide the best battery life of the group: 4 hours 32 minutes for the NP-902, 3 hours 2 minutes for the NP-903. Unfortunately, it takes 8 hours to recharge those batteries when the unit is off.

MicroStar claims that with all the power-conservation features engaged (processor speed cut in half, screen and hard disk in sleep mode), the two batteries can last over 5 hours. Power conservation, handled through setup, is triggered by a user-specified interval of inactivity (up to 7 minutes). If you carry an extra battery or two, you have what amounts to a full workday without having to recharge. But keep in mind that each battery weighs almost 2 pounds.

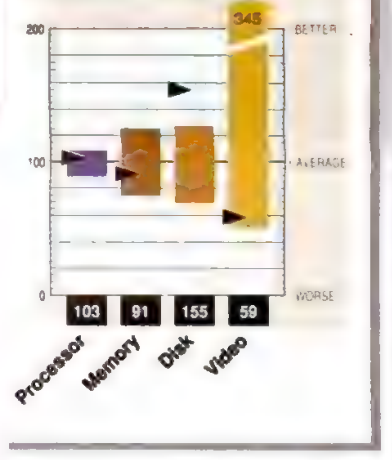
Both NoteStar notebooks have a Sanyo triple-supertwist backlit LCD that produces a very sharp image within a relatively narrow brightness range. Even at

Plug-in modules make selecting the NoteStar NP-902 and NP-903's accessories as easy as popping a videocassette into a VCR.

MicroStar NoteStar NP-903

Battery Life: 3 hours 2 minutes.

TEST RESULTS



In Short: Similar to the NoteStar NP-902, but more powerful, the NP-903 packs a 386SX CPU and a 60MB hard disk. The 3-hour dual-battery life makes up for this system's 16-MHz speed rating, though you will gain nearly a pound of travel weight when you add the second battery. Modules for SCSI and network interfaces, fax/modem, and other options differentiate this notebook from the pack.

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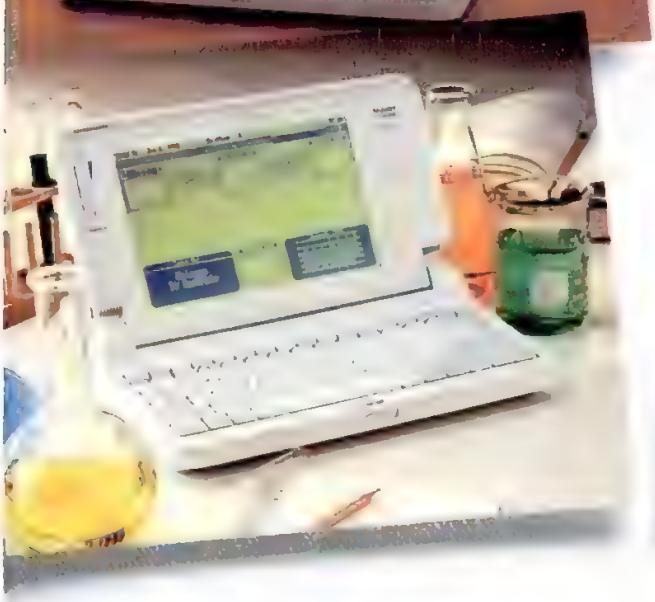

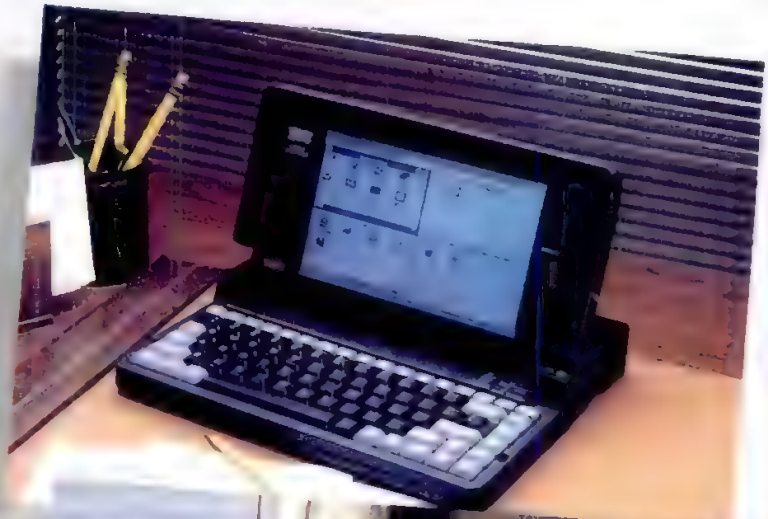

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All three are 1.7 × 12.2 × 10″ and feature stunning VGA graphics, one megabyte of memory, and a 1.44-megabyte floppy drive.

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CIRCLE 289 ON READER SERVICE CARD

full brightness, the screen appears a little dimmer than some. This doesn't seriously affect the contrast, however, or the large gray scale: The NoteStar NP-902 has 32 shades, and the NoteStar NP-903 has 64. Both models work well with Microsoft Windows 3.0. The only other problems were some bright spots along the edges of the screen and a bit of image echo. On each model, screen controls are conveniently placed just to the left of the display.

Both keyboards have 83 keys. Separate position keys (Home, End, PgUp, and PgDn) are arranged in a vertical row along the right side of the keyboard; cursor keys are laid out conveniently, in an inverted T at the bottom of the keyboard. All the keys have standard spacing and a responsive feel that makes typing a pleasure.

ACCENT ON SERVICE AND SUPPORT

MicroStar emphasizes service and support. Going beyond a conventional one-year warranty, the company pays for next-day air freight both ways and guarantees a 48-hour turnaround. Also unusual is that MicroStar has twice as many technical support people as sales personnel. When you consider this level of service in conjunction with the technical features, it is hard to believe that you can still buy the NoteStar notebooks for less than $2,000.

If they weighed a bit less and had a slightly brighter screen, you would be hard-pressed to find a much better alternative at any price.

FACT FILE

NoteStar NP-902
MicroStar Computers Inc., 35 Cotters Ln., #C-1, E. Brunswick, NJ 08816; 908-651-8686.
List Price: $1,730.
Tested Configuration: 2MB RAM, 40MB Conner hard disk, 1.44MB floppy disk drive, DOS 4.01, AC power adapter, carrying case.
Options: 2MB RAM upgrade, $100; 4MB RAM upgrade, $200; external floppy disk drive with second serial port, $249; 80387SX coprocessor, $125; extra battery, $63; external battery charger, $189; car battery adapter, $24; ARCnet adapter, $139; Ethernet adapter, $179; SCSI adapter, $89; 2,400-bps modem, $168; 2,400-bps modem with MNP 5 data compression, $209.

CIRCLE 429 ON READER SERVICE CARD

MICRO TELESIS INC.

Micro Telesis Jetbook-386SX

BY JOHN R. QUAIN With an exterior design reminiscent of 1950s kitchen appliances and weighing a scant 6.7 pounds with battery, the Micro Telesis Jetbook-386SX distinguishes itself in this roundup by delivering the quickest VGA screen performance—and one of the shortest battery times. Equipped with a 40MB JVC hard disk, a 1.44MB floppy disk drive, DOS 5.0, and a soft carrying case, this $1,699 notebook is made by Taiwan-based Jetta International and sold directly by Micro Telesis.

Using an Award BIOS with password protection, the 2- by 11- by 8.5-inch Jetbook uses a 20-MHz 386SX CPU and a Chips and Technologies chip set. The system came with 3MB of DRAM in 70- and 80-nanosecond SIMMs. Though using greatly disparate DRAM can occasionally cause problems, this system appeared unaffected by the mix of different-speed memory chips, turning in average results. The Jetbook can handle up to 16MB of

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RAM, using 4MB SIMMs ($849)—nearly three times as much as most notebooks in this class.

The backlit supertwist Sanyo LCD screen is controlled by a Cirrus Logic chip set. Able to deliver 64 shades of gray, the VGA chip set was responsible for achieving the best video score in this roundup. The image detail of the Jetbook's 5.3- by 7.2-inch screen compares well with that of others in this group. A VGA port allows you to connect an external CRT monitor, though the chip set will not drive both screens concurrently. Controls for contrast and brightness are protected inside the case, just above the keyboard.

The power button is also thoughtfully placed inside, above the keyboard, thereby eliminating the possibility of accidentally switching the unit on while in transit. The battery, shaped like a dynamite stick, slides neatly into the Jetbook without requiring any plugs or connectors. Its performance did not create much of a bang, however. Rated to last 2.7 hours during normal use, on PC Magazine Labs' Battery Rundown test the battery squeezed out a paltry 1 hour 47 minutes—the third-slowest time in this review.

Recharging the battery takes 6 hours with the Jetbook on and 5 hours with the unit off. Though the standard power-management features (including screen, disk, and CPU sleep-mode settings of 1 to 10 minutes) improve battery endurance, you should consider getting an extra battery ($65) and a 1.5-hour battery charger ($49) to reduce charging times. Buyers should also note that the supplied power adapter/charger uses special timer circuitry intended to keep the battery from overheating: It stops the charging process after 8 continuous hours. (With an extra battery and the supplied power adapter, the system weighs just 9.5 pounds.)

Including a full array of 12 function keys and an L-shape set of four cursor keys, the 86-key keyboard has a light, clicking action and feels slightly sticky compared with desktop PC keyboards. The external keyboard connector is on the Jetbook's left side, and the floppy disk drive on the right will conflict with a right-handed trackball device, such as Microsoft's BallPoint Mouse.

With its 40MB JVC hard disk, the evaluation unit placed in the bottom third on our disk test. Micro Telesis offers two other hard disk options: 60MB and 80MB Conner drives for $175 and $400, respectively. Additional options can be connected to the back of the notebook using the parallel, serial, or floppy-disk-drive ports. A 100-pin connector accommodates a $279 docking station that contains

FACT FILE

Micro Telesis Jetbook-386SX
Micro Telesis Inc., 17891 Skypark Circle, #E, Irvine, CA 92714; 714-557-2003.
List Price: $1,699
Tested Configuration: 3MB RAM, 40MB JVC hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case.
Options: 60MB unit, $175; 1MB RAM upgrade, $60; 4MB RAM upgrade, $240; 80387SX coprocessor, $129; numeric keypad, $75; expansion chassis, $279; extra battery, $65; external battery charger, $49; car battery adapter, $45; Ethernet adapter, $249; 2,400-bps modem, $110; 2,400-bps modem with MNP 2-7 error correction/data compression, $125; 2,400-bps send-and-receive fax modem, $195; 9,600-bps modem, $575; leather carrying case, $179.

CIRCLE 542 ON READER SERVICE CARD

The Original V.32bis and Fax Modem

The Original
That's right, Digicom Systems, Inc. was the first modem manufacturer to introduce V.32bis and CCITT Group 3 send and receive fax capabilities in the same modem.

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The 9624LE Plus operates at 14,400 bps true full duplex, which is 50% faster than V.32 modems and 6 times faster than 2400 bps modems. Effective throughputs of 38,400 bps can be achieved when you add V.42bis data compression. The 9624LE Plus also supports V.42 error correction and MNP levels 2 through 5, allowing you to transmit error-free data.

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With Digicom Systems' Adaptive Rate feature, the 9624LE Plus negotiates the best connection automatically, by falling back to lower speeds when the line quality is bad and falling forward as the line quality improves.

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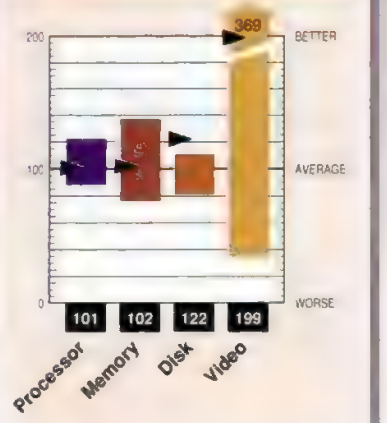
CIRCLE 188 ON READER SERVICE CARD

The Micro Telesis Jetbook-386SX's Sanyo screen is controlled by a 64-gray-shade Cirrus Logic chip set that yielded the fastest video score.

Micro Telesis Jetbook-386SX

Battery Life: 1 hour 46 minutes.

TEST RESULTS



In Short: A reasonable price, an excellent VGA video score, and an error-correcting internal modem option are this notebook's strong points. Battery performance was less noteworthy, however. The 6.5-pound $1,699 Micro Telesis Jetbook-386SX ran for only 1 hour 46 minutes, but it put in by far the fastest video performance in this group.

one half-length and two full-length 16-bit ISA slots.

The Jetbook can accept a 80387SX coprocessor ($129), but you will have to send the unit back to Micro Telesis to have it put in. You can install the $110 2,400-bps modem yourself, though.

As with most of the units in this roundup, there are tradeoffs to be considered, such as the poor battery performance but excellent video score. Trying to mitigate those tradeoffs, Micro Telesis offers a $1,599 version of the 20-MHz Jetbook-386SX with 1MB of RAM and a 20MB hard disk. The company covers the system with a warranty of 13 months on parts and two years on labor. There is no toll-free technical support, but customers can receive assistance by making a toll call. Micro Telesis hopes to offer an 800 number in the first quarter of 1992.

NATIONAL MICRO SYSTEMS INC.

Flash NT386SX-20

BY JOHN R. QUAIN National Micro Systems shows how computing on the road can cause as many traveling travails as productive passages. While the $1,999 Flash NT386SX-20 offers the benefits of a long battery life and a clear, bright display, it is hamstrung by a slow hard disk, pedestrian video performance, and an unconventional keyboard layout.

Though the 20-MHz 386SX notebook weighs more than 7 pounds (with battery), that weight includes a 2,400-bps internal modem with a send/receive fax and MNP 5 error correction. Add the supplied power adapter and an extra battery ($85) and the package will add over 10 pounds to your baggage.

For the *PC Magazine* configuration, National Micro also included a 40MB 19-millisecond Seagate hard disk, DOS 5.0, *BitCom* communications software, a scanner interface, and a soft carrying case. This was the only appearance of a Seagate drive in this roundup, and it called attention to itself by placing second to last on PC Magazine Labs' disk test. (National offers one hard disk upgrade: a 60MB Conner drive for $200.)

A little bulkier than most of the notebooks in its class, the 2.5- by 11.4- by 8.6-inch Flash can manage a total of 5MB of 80-nanosecond DRAM. You can upgrade the system memory, located beneath the keyboard, for $75 per megabyte. The 20-MHz 386SX-based system uses an Amrel Technologies motherboard and a Headland/Acer chip set. The accompanying AMI BIOS allows BIOS shadowing but has no password protection and no video-shadowing option. The latter deficiency proved a significant drawback.

On the video benchmark test, the Flash recorded the worst score in the current group—primarily the result of two factors: the absence of video shadowing, which was enabled for tests on competing notebooks, and the system's 8-bit Cirrus Logic chip set. This is disappointing news,

FACT FILE

Flash NT386SX-20
National Micro Systems Inc., 2979-B Pacific Dr., Norcross, GA 30071; 800-642-7649.
List Price: $1,999.
Tested Configuration: 2MB RAM, 40MB Seagate hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case.
Options: 60MB unit, $200. 1MB RAM upgrade, $75; 4MB RAM upgrade, $300; external floppy disk drive, $175; 80387SX coprocessor, $195; numeric keypad, $75; expansion chassis, $425; extra battery, $85; 2,400-bps send-and-receive fax modem, $225.

CIRCLE 543 ON READER SERVICE CARD

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DID YOU MISS IT?

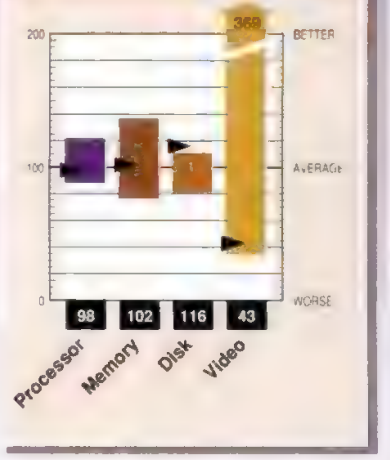
Whatever you do, DON'T MISS the new ZEOS NOTEBOOK PRICES! Turn back to page 129 for HOTTEST PRICES on the HOTTEST NOTEBOOKS money can buy!

A long battery life helps the Flash NT386SX-20, but a slow hard disk hampers its performance.

Flash NT386SX-20

Battery Life: 2 hours 50 minutes.

TEST RESULTS



In Short: A crisp display and long battery life are hallmarks of National Micro Systems' 20-MHz Flash NT386SX-20 notebook. Unfortunately, so is a very poor video speed. And while it was the most enduring of the tested 20-MHz systems in terms of the Battery Rundown test on the video test the Flash was the slowest of the group. Users may still find that some features, such as the send/receive fax/modem, offset the performance penalties.

considering the quality of the 32-gray-scale Sharp backlit display, which is bright and almost completely devoid of the banding effects common in LCD screens. The notebook can handle an external VGA CRT but cannot run both displays concurrently.

You may find yourself waiting for the screen to scroll, but the Flash NT386SX-20's rechargeable battery won't mind the wait. The 1.2-pound battery can't outlast the drum-beating Eveready rabbit, but with a time of 2 hours 50 minutes, it lasted more than half an hour longer than any other 20-MHz notebook in this issue. You can extend the life even further by enabling separate sleep modes for the display, hard disk, and CPU in increments from 1 to 99 minutes. The only shortcoming here is the lack of an optional battery charge stand, so recharging takes 5 hours with the system on and 2 hours when it is turned off.

One tradeoff of the Flash design: Touch-typists will find that the keyboard's 82-key layout requires some adjustment. The four arrow keys are laid out in an L shape. And on the bottom right side of the keyboard, the Ctrl, Alt, Fn, Ins, and Del keys sit next to each other in a horizontal row—a lineup that can result in some nasty mistakes if you're not careful. For more comfortable typing, you can hook up a full-size keyboard.

A Citizen 1.44MB floppy disk drive is located in front, below the keyboard, so you can attach a trackball device to either side of the keyboard. There is also a proprietary docking port that accommodates a $425 expansion station with two full-length 16-bit ISA slots. That is less expensive than many major companies' docking stations but more costly than any in this review, save Tangent's.

One minor ergonomic nuisance is the power button, which can be accidentally switched on by some minor jostling in a crowded briefcase. A power indicator on the outside of the notebook, however, will alert you when you have inadvertently fired up the system.

Even with the sluggish screen and disk, some users will find this direct marketer's total package enticing. National Micro Systems completes the Flash NT386SX-20 with thorough documentation, a one-year warranty, and toll-free technical support. If you feel the performance drawbacks are offset by the positive features, consider doing without 1MB of RAM and the modem/fax, bringing the price down to $1,799.

TANGENT COMPUTER INC.

Tangent Model 320N Voyager SX

BY JOHN R. QUAIN Choosing the best notebook PC with the most options can be as agonizing for direct marketers as it is for buyers. For its 20-MHz 386SX notebook offering, the Tangent Model 320N Voyager SX, Tangent Computer has made some good choices—and some disappointing ones. The $1,999 Voyager offers a multitude of options and is $800 less than the identical PC from Northgate. But though the basic unit costs less, Tangent's options are often expensive. Also, on PC Magazine Labs' tests, the Voyager had little battery endurance—a problem noted with the Northgate's system in the past.

In the *PC Magazine* configuration, the Voyager comes with 3MB of RAM, DOS 5.0, and a dual-voltage power adapter. Our unit also included an internal 2,400-bps modem with send/receive fax, *BitCom* software, MNP 5 error correc-

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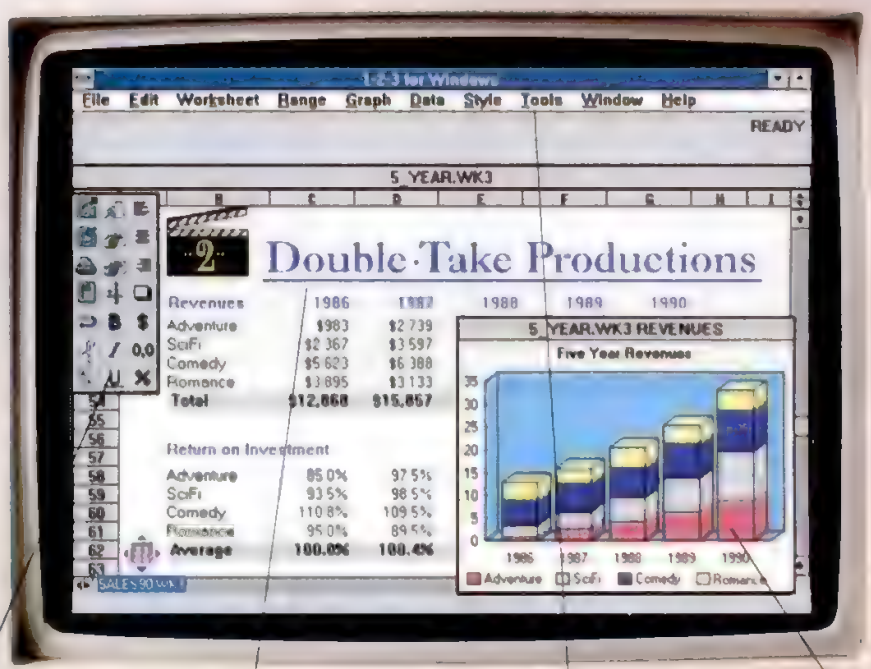

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Interactive graph gallery lets you preview and select by example a wide range of chart and graph types.

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deliver a balance of power and simplicity. And third, make it fully compatible with the earlier versions of 1-2-3 that millions of users are familiar with.

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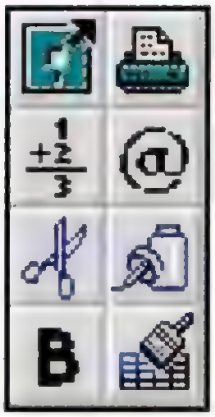

Customizable SmartIcons give you push-button access to basic and advanced spreadsheet functionality. Over 50 standard icons come with the program, or create new icons to suit your needs. For example, sum a column or a row, or change text to bold—all in a simple step.

One of the first things you'll notice about 1-2-3 for Windows is its SmartIcons™—simple, one-click shortcuts to performing common spreadsheet tasks. For example, sum a row of numbers, make text bold, create a graph, save or print a file, even run a macro—all in a single step.

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Unlike the Toolbar™ in Microsoft® Excel, 1-2-3 for Windows actually lets you create your own icons for the tasks that are unique to you.

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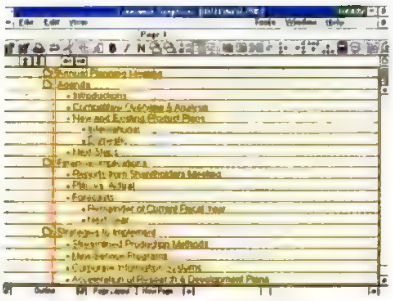

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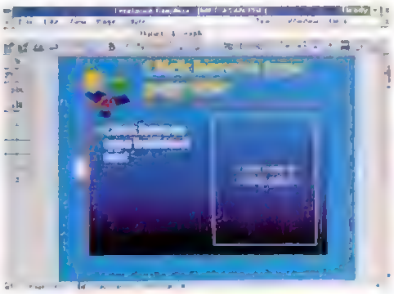

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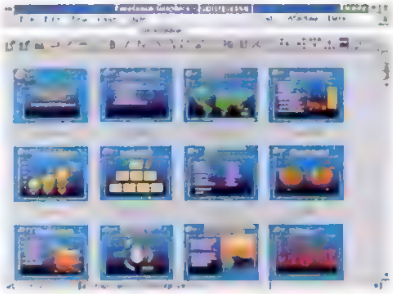

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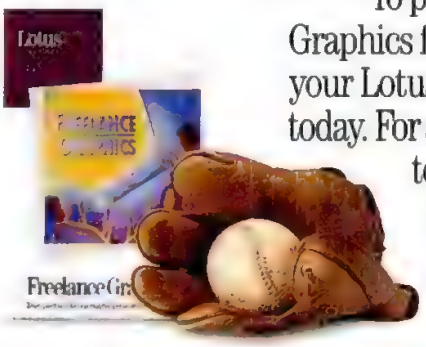

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FACT FILE

Tangent Model 320N Voyager SX
Tangent Computer Inc., 197 Airport Blvd., Burlingame, CA 94010; 800-223-6677, 415-342-9388.
List Price: $1,999.
Tested Configuration: 3MB RAM, 40MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter.
Options: 60MB unit, $195. 2MB RAM upgrade, $200; 4MB RAM upgrade, $400; external floppy disk drive, $219; 80387SX coprocessor, $165; numeric keypad, $79; five-slot expansion chassis, $595; eight-slot expansion chassis, $795; extra battery, $175; Ethernet adapter, $495; 2,400-bps modem with 9,600-bps send-and-receive fax and MNP 5 data compression, $349; car battery adapter, $89.

CIRCLE 546 ON READER SERVICE CARD

tion, and a price tag of $349.

For serious travelers, the Voyager is compact and battened down for heavy weather. Snap-out panels are snug and won't pop out unexpectedly. With the battery and modem installed, it weighs a mere 6.4 pounds, measures less than 2 inches thick, and has a footprint that's only 8.3 by 11.5 inches. Lay in a spare battery and a power adapter and the whole package still weighs only 8.6 pounds.

Most itinerant PC workers will feel that the real pitfall of the Voyager is poor battery performance. Rated for 2 hours, the battery managed to hold on for only 1 hour 24 minutes on PC Magazine Labs' Battery Rundown test. To compensate, Tangent incorporates several power-saving utilities, including a BIOS setup routine to adjust display, hard disk, modem, and CPU sleep-mode intervals from 1 to 9 minutes. Rest assured, the Voyager's early-warning blinking light and loud beeps will let you know when the battery is about to succumb. If you choose this notebook, keeping it running on extended trips is expensive: You will want to buy an extra battery for $175. Unfortunately, Tangent does not sell a standalone battery charger.

Disk storage, in the form of an Epson 1.44MB floppy disk drive, is on the right side, under the keyboard. Its position makes it awkward for right-handers to connect a Logitech or Microsoft trackball on the side without blocking the drive. More important, the performance of the 40MB 19-millisecond Conner hard disk was disappointing. It turned in the slowest disk score of the 15 reviewed portables—though several others were not much faster.

These shortcomings aside, seeing your work won't be a problem. The Voyager's dual-hinged sidelit Sharp triple supertwist LCD screen produces 32 shades of gray in VGA mode. Slider controls for brightness and contrast are located under the screen, so they won't be inadvertently nudged when the notebook is closed. The 5.3- by 7-inch screen is a little smaller than some others, but it elicits a minimum amount of streaking in graphics applications. PC Labs' video test put the Voyager in the top five, though its times were less than startling. Output to an external CRT monitor yields 800- by 600-pixel resolution, but you can't operate both displays simultaneously.

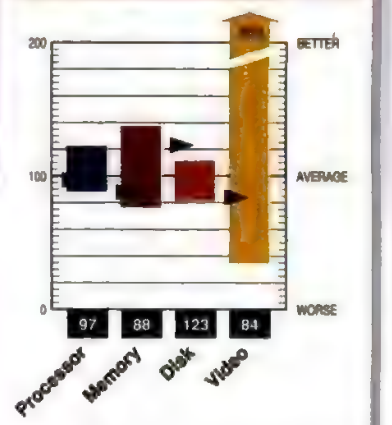
To transform the Voyager completely into a desktop system, you can also hook up an external keyboard or numeric keypad. Most users will find the Voyager's 85-key keyboard more than adequate, however. Its quiet-clicking key action is a little stiff, but the keys offer more travel than those on most notebooks. Separate cursor keys are positioned in an inverted-T shape, and a full complement of 12 re-

A light weight, a car battery adapter, and a fine internal modem are among the many benefits the Tangent Model 320N Voyager SX offers.

Tangent Model 320N Voyager SX

Battery Life: 1 hour 23 minutes.

TEST RESULTS



In Short: A solid notebook computer in most respects, the Tangent Model 320N Voyager SX is handicapped by a short battery life. The company offers users a variety of options for this otherwise respectable performer, and shoppers can pay as much as $800 more for the identical PC from other vendors. But nothing short of an extra battery will save you in mid-flight.

duced-size function keys are arranged in two rows across the top.

Using a screwdriver, you can pop open the keyboard for access to the Quadtel motherboard, where you will find room for a math coprocessor, additional memory, and a modem. The 3MB of 80-nanosecond DRAM in the Voyager performed a little below average on the memory test. Tangent offers a $400 4MB DRAM module to raise the total system memory to 5MB, but you will have to toss out the $200 2MB module to install it.

Like most notebooks, the Tangent Model 320N Voyager SX has its faults, not the least of which is poor battery life. However, the company offers such benefits as free one-year on-site service (via TRW), toll-free technical support, and options such as a $145 60MB hard disk or $245 80MB hard disk upgrade. There is no expansion-bus option, but if you're looking for more, you're looking for a desktop machine.

USA FLEX INC.

USA FlexNote 20

BY ALFRED POOR If you've ever been allotted a single sheet of notes for an open-book exam, you probably discovered just how much you could cram into an 8.5- by 11-inch package. If not, take a look at the USA FlexNote 20, from USA Flex. The company has set the list price firmly at $1,995 and then proceeded to see how many extras it could bundle with the computer.

Though simultaneous display is not possible, the USA FlexNote 20 is capable of 800-by-600 Super VGA on an external monitor.

The 20-MHz FlexNote, like most competing machines, includes DOS 5.0. It measures 2.5 by 11 by 8.5 inches and weighs 6.9 pounds with the battery installed. You also get Microsoft Windows 3.0, along with a Logitech serial mouse so you can run the software. Still, you need some application software, and the FlexNote has that covered with the *PFS:WindowsWorks* integrated software package. And you get *PC-Test* diagnostic software to round out the bargain.

While other machines have basic models with 1MB of RAM and a 40MB hard disks, the FlexNote comes with 2MB of RAM and a 60MB Conner hard disk. Besides allowing 3MB more RAM, for a maximum of 5MB, the FlexNote leaves room for a 80387SX/20 coprocessor ($150).

The notebook managed only 1 hour 47 minutes on a charge when none of its screen and hard disk conservation techniques were employed. USA Flex recognizes that this is not enough and includes a second 1.1-pound nickel cadmium battery pack with every FlexNote—something most companies offer only as an extra-cost option.

SUPER VGA CAPABILITY

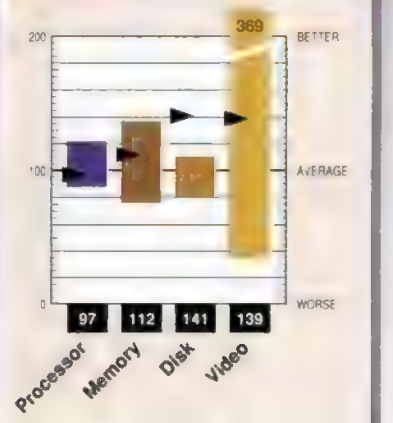
Though simultaneous display is not possible, the FlexNote is capable of 800-by-600 Super VGA on an external monitor.

Along with lots of extras, USA Flex includes a free battery to compensate for the USA FlexNote 20's short battery life.

USA FlexNote 20

Battery Life: 1 hour 47 minutes.

TEST RESULTS



In Short: The 20-MHz USA FlexNote 20 includes lots of extras, such as a 60MB hard disk, Microsoft Windows 3.0, *PFS:WindowsWorks* integrated software, a mouse, and an extra battery pack. The system's biggest drawbacks are an awkward keyboard configuration and a ghosty screen. Nevertheless, you can't beat the bargain.

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FACT FILE

EDITORS' CHOICE

USA FlexNote 20
USA Flex Inc., 135 N. Brandon Dr., Glendale Heights, IL 60139; 708-351-7334
List Price: $1,995
Tested Configuration: 2MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, *PFS: WindowsWorks*, extra battery, AC power adapter, carrying case
Options: 1MB RAM upgrade, $180; 4MB RAM upgrade, $360; 80387SX coprocessor, $129; expansion chassis, $399; car battery adapter, $99; 2,400-bps modem with 9,600-bps send-only fax, $169

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Its own screen—a Sharp supertwist LCD with CCFT (cold-cathode fluorescent tube) backlighting—allows only VGA resolution. Other drawbacks include a very narrow adjustable range for brightness and vertical ghosting on lots of the characters.

You will also have to adjust to the FlexNote's keyboard. Cursor keys are arranged in an L shape along the lower-right corner, with the half-size arrow keys serving double duty as Home, End, PgUp, and PgDn through a special Fn shift key. The F1 and F2 keys double as F11 and F12, and all the top-row keys—Fn, Esc, Ins, and Del—are also half-size. A keyboard port, however, lets you use an external keyboard.

The case is solidly built, but the power button is located on the front corner of the left side, where it is too easy to press by accident. The lone serial port requires you to use the internal modem if you want a mouse and modem at the same time. USA Flex markets a 2,400-bps modem with 9,600 send-only fax for $179. USA Flex doesn't sell an external floppy disk, though the FlexNote has a connector for one. Instead it offers a $399 expansion unit that goes on an expansion port.

You may not love the USA FlexNote 20's keyboard, but you will surely love the extras USA Flex packs into a $2,000 package. For computing on a budget, few systems can beat this value. ■

Bruce Brown and Alfred Poor are contributing editors of PC Magazine. *Henry Fersko-Weiss, Edward Perratore, John R. Quain, and Tom Unger are free-lance writers and frequent contributors to* PC Magazine.

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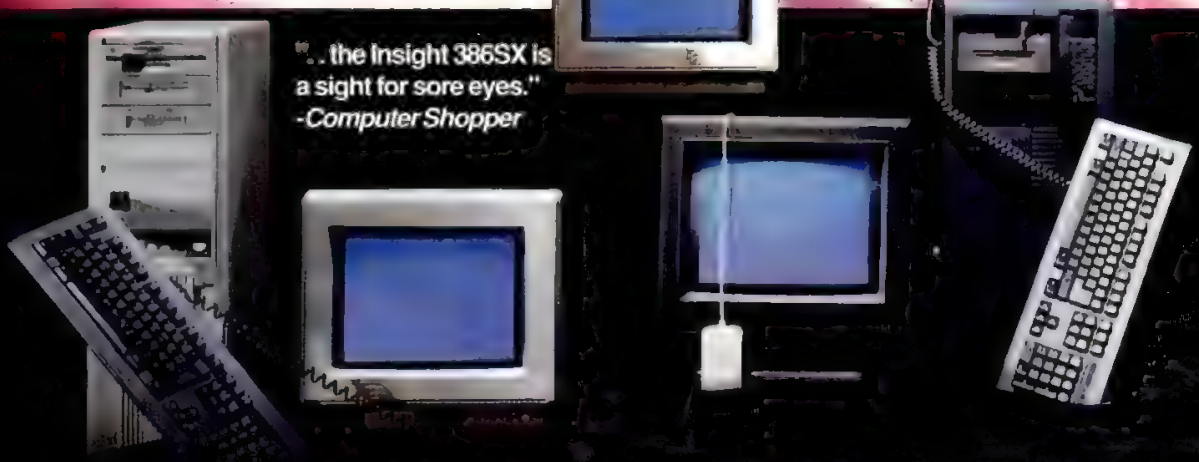

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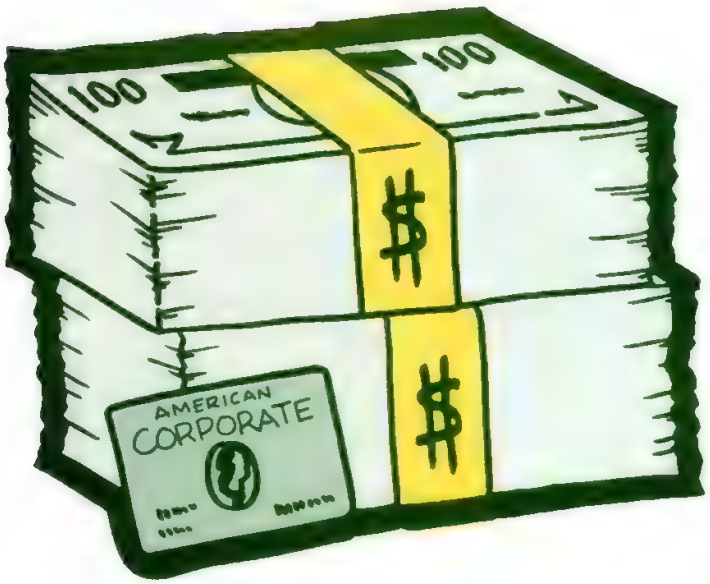

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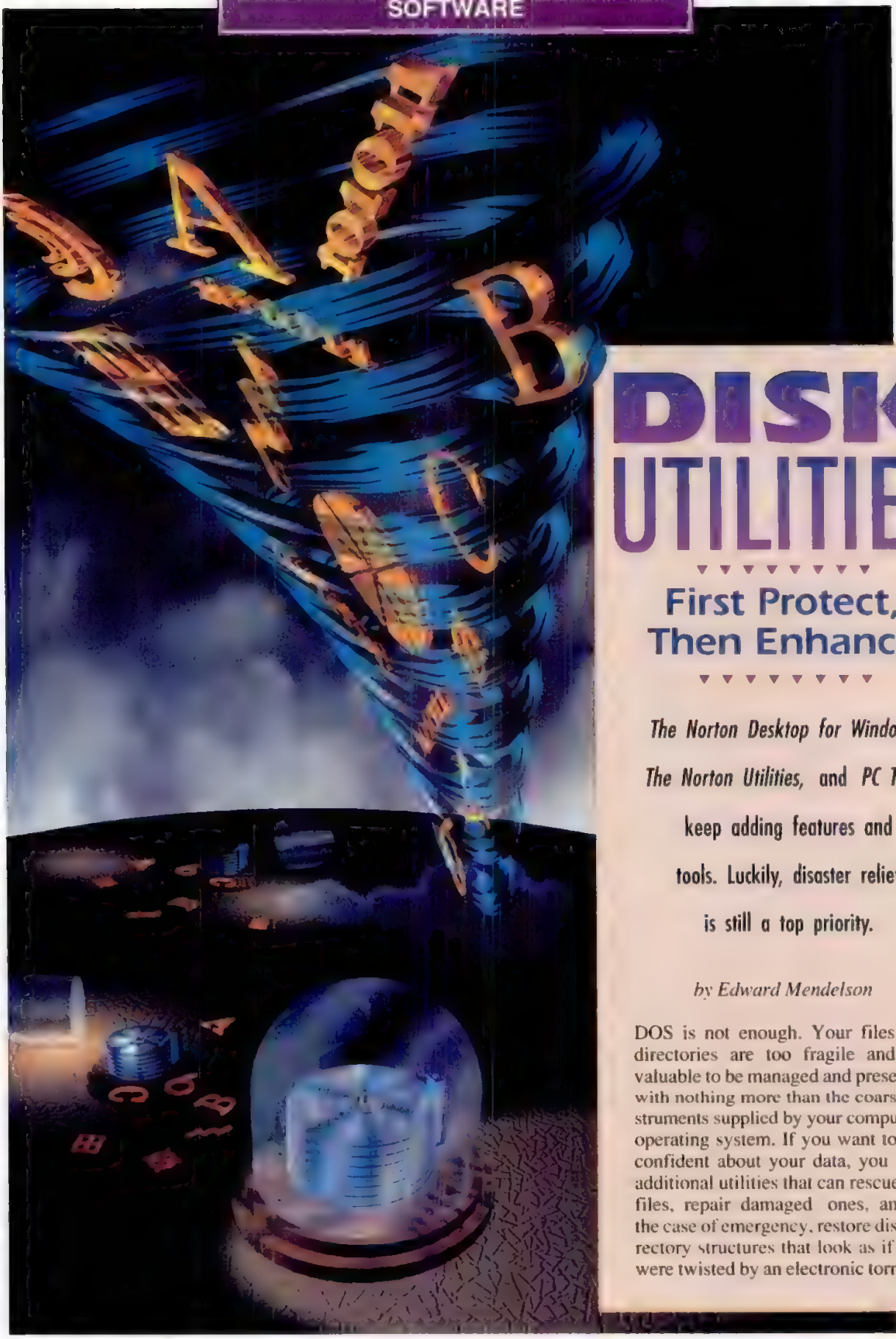


DISK UTILITIES

First Protect, Then Enhance

The Norton Desktop for Windows, The Norton Utilities, and PC Tools keep adding features and tools. Luckily, disaster relief is still a top priority.

by Edward Mendelson

DOS is not enough. Your files and directories are too fragile and too valuable to be managed and preserved with nothing more than the coarse instruments supplied by your computer's operating system. If you want to feel confident about your data, you need additional utilities that can rescue lost files, repair damaged ones, and in the case of emergency, restore disk directory structures that look as if they were twisted by an electronic tornado.

ILLUSTRATION: JIM LUDTKE

Since DOS first appeared in 1981, tens of millions of users have relied on DOS alone to maintain their files, and many of them have had to deal with lost data and wasted work. DOS always made it possible for other packages to restore deleted files, because when it deletes a file, DOS leaves the data on disk and the directory entry in place, except for the first character of the filename. But DOS 5.0 was the first version to offer its own utilities for recovering deleted files and restoring formatted or scrambled disks. (See the sidebar "How DOS 5.0 Compares with the Data Recovery Utilities.") The DOS 5.0 utilities, welcome and useful as they are, can't approach the security offered by the advanced utility packages reviewed in this story: *The Norton Desktop for Windows*, Version 1.0; *The Norton Utilities*, Version 6.01; and *PC Tools*, Version 7.1.

All of these packages give you ways of recovering not only formatted disks and recently deleted files but also files in subdirectories that were removed from your disk long ago. They can resurrect files from scattered fragments of deleted text and patch up wounded databases and spreadsheets. Except for the programs that dig deeply into the directory structure, they all work as effectively on networks as on standalone machines.

DOS's CHKDSK has always been able to unscramble a muddled file allocation table (FAT), but often it does more harm than good in the process. These packages can give you a FAT that allows perfect or near-perfect access to otherwise inaccessible data. Each FAT can intercept DOS's attempt to delete files and store the data in a hidden directory for guaranteed recovery afterward or automatically warn you before you delete files you may not intend to destroy. DOS 5.0 can recover files on a formatted disk, but these packages can also restore a hard disk's boot sector and test for minute damage on a disk's surface that DOS doesn't notice—yet.

You can misplace data on a large hard disk even without deleting a file. All three of these packages help you find a needle of data in a haystack of directories, and all three let you fine-tune your directory structure in ways far simpler and more intuitive than anything possible with DOS alone. *The Norton Desktop for Windows* and *PC Tools* include backup programs to preserve data away from your machine. And when, for security reasons, you do want data to disappear forever, all of these programs let you obliterate a file beyond hope of recovery.

EVOLVING TOGETHER

The Norton Utilities and *PC Tools* are the long-standing rivals in the DOS utility market, and with each new version, the disk and file utilities in one package increasingly look and work like the corresponding utilities in the other. (Another rival, Fifth Generation Systems' *Mace Utilities*, was not reviewed because a new version is still in the planning stage.) In its latest version, *PC Tools* comes with one or two Microsoft Windows–based versions of its DOS programs, but *The Norton Desktop for Windows* is the first of what will probably be a large field of all-purpose, all-Windows utility packages.

None of these packages limits itself to disk and file repair. *The Norton Utilities* is one up on DOS with a sleek replacement for COMMAND.COM and miscellaneous configuration and security programs. *PC Tools* adds a file manager, remote-control and security programs, and a DOS desktop complete with calculators,

DISK UTILITIES: SUITABILITY TO TASK

The three disk utilities reviewed in this article were evaluated for their suitability in handling four types of tasks. We evaluated each program in four respects and expressed our findings on a scale of one to four.

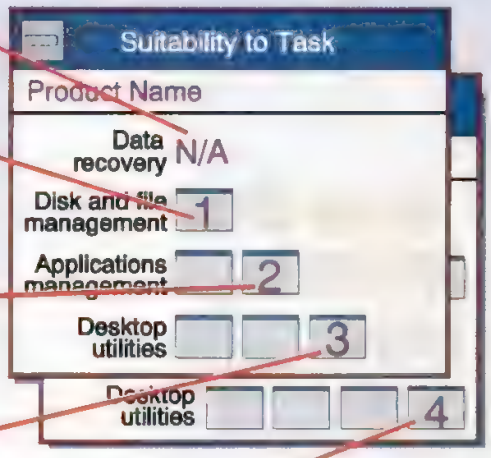
The **data recovery** score indicates the package's ability to recover and repair deleted and damaged files. We used *Lotus 1-2-3* and *dBASE* files in our testing, and we also rewrote the partition table of a multipartition disk to see if the package could recover the partitions automatically.

To receive a good **applications management** score, the package should have a customizable application launcher, task-switching features, the ability to load and unload TSRs on demand, and the ability to feed keystrokes to applications after launching them.

For **disk and file management**, we created a complicated directory structure with thousands of files and attempted to copy and cut directory branches, move them from level to level, view hidden files, and delete read-only files.

The considerations for **desktop utilities** include a calculator, a calendar, a scheduler, a rudimentary database, remote communications software, workgroup scheduling, fax board support, and an outliner. For Microsoft Windows packages, we also look for a font viewer, icon manager, and screen blanker, and take note of the advantages they offer over Windows' own utilities.

N/A—Not applicable: The product does not perform this task.



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2—Fair

3—Good

4—Excellent

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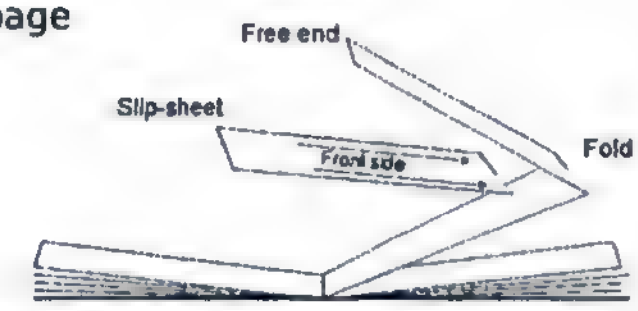

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Inverted Back

1. Follow instructions on the other side

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- Serial mouse
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- MS Windows 3.0
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- MS Windows 3.0
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notepads, and other handy desk implements. *The Norton Desktop for Windows* lets you control and customize the Windows environment and gives it some conveniences otherwise available only on a Macintosh.

MORE THAN YOU NEED?

If you let these packages install themselves with all available options, your computer may be burdened with more TSRs and internal protective armor than you need. In most reasonably secure settings, you probably won't want to bother with the TSRs provided by the *Norton* products and *PC Tools*, which ask your permission before allowing anything to be written to the disk. Such programs tend to annoy you far more than they protect you. You may not need the full delete protection provided by TSRs, which store deleted files; these quickly fill up disk space and need to be purged at regular intervals.

You will definitely want to run the Mirror program that comes with *PC Tools* or DOS 5.0 (whose Mirror program comes from an earlier version of *PC Tools*) or the faster Image program that comes with *The Norton Utilities*. These programs save a copy of your disk's FAT and root directory—enough information to permit perfect recovery of files whose data hasn't been overwritten by other files. And each time they run, they preserve a backup of the most recent version for even better security.

You have to use Mirror and Image with some care. If you run one of them on Monday and delete a file on Tuesday, the undelete programs in DOS, the *Norton* packages, and *PC Tools* can recover the file perfectly, even if it is split into fragments. But if you run Mirror or Image on Wednesday and again on Thursday, and only then try to recover the file, the undelete program won't find any record of the scattered file fragments in either the latest or the backup copy of the FAT and root directory; these copies contain only the current directory structures, not the one in effect before the file was deleted.

All is not lost, however. Your DOS directory still contains the size of the deleted file and the location of its first cluster, and the undelete program can easily recover at least the first fragment of the file. The manual undelete functions in the *Norton* software and *PC Tools* can help retrieve the rest. The moral is that you should run Mirror or Image in ways that reflect the way you work. If you generally need to recover files immediately after deleting them, put either Image or Mirror in your AUTOEXEC.BAT and run it daily. If you tend to need deleted files only after a few days, run Image or Mirror once a week or so.

You can also use the optional delete-tracking feature in DOS 5.0's Mirror or *PC Tools*' Diskmon to supplement the normal Image or Mirror copies of the FAT. The delete-tracking TSR records the full location of deleted files in a separate file, and undelete programs (including those in both *Norton* products) can use this information to recover a file if the data has not been overwritten by DOS. However, if you find it worthwhile to use a TSR to track the location of deleted data, you might as well use the *Norton* or *PC Tools* TSR that actually stores the deleted data itself, but if you are using a *Norton* package make sure to modify the defaults so the deleted data doesn't swallow up your disk space.

Your preferred method of preserving data—or the method established by your organization—depends on the sensitivity of your files, your work habits, and the risks you are willing to accept. Whatever method you choose, one thing is certain: You'll sleep far easier and work far more confidently if you use one of these three packages rather than relying on DOS and luck.

EDITORS' CHOICE

■ ***The Norton Utilities***

For delivering peace of mind when disaster looms, *The Norton Utilities*, Version 6.01, continues to outrank its competition. The Norton Disk Doctor, *Norton*'s disk and directory repair program, hides exceptional intelligence behind a friendly interface that lets you unscramble a disk without the ammunition of vast technical knowledge.

The Norton Utilities does not deliver the wealth of features found in *PC Tools*, Version 7.1, or in *The Norton Desktop for Windows*, Version 1.0, since it is totally dedicated to disk maintenance. In fact, many people will want all three. *The Norton Desktop for Windows* is one of the best tools around for making Microsoft Windows easier to use; it combines some of the most needed everyday utilities for Windows (backup, disk maintenance, and file viewing) at a price closer to single-function utilities.

And if you're trying to stock a system with the broadest range of DOS utilities (calendar, disk organizer, disk backup, and so on), you won't find a better value than *PC Tools*. In addition to the abundant features found in recent versions, the new release adds one of the best remote communications programs available for home-to-office use.

Still, these two products don't equal *The Norton Utilities* in one area that is absolutely critical: Both are fine additions to your disk management toolbox, but *The Norton Utilities* is a must-have for data recovery.

The Norton Desktop for Windows

Symantec Corp.'s *The Norton Desktop for Windows*, Version 1.0, resembles *PC Tools*, the combined disk-and-desktop utility package, more than it resembles the same company's collection of DOS and disk programs, *The Norton Utilities*. But the *Norton Desktop* package ($149) is the first attempt at a full-scale utility package for the Microsoft Windows environment, and it is both impressive for the enormous range of its achievement and frustrating for what it promises but doesn't deliver.

Most of the package consists of two distinct kinds of utilities. First is a set of

Suitability to Task

The Norton Desktop for Windows

Data recovery	3
Disk and file management	4
Applications management	4
Desktop utilities	3

replacements for the standard Windows Program Manager and File Manager, complete with additional Windows enhancement programs that you won't find in Windows itself. Second is a set of disk and file utilities that resemble standard DOS utilities; these include a Windows version of *The Norton Backup*, an unerase program, and a diagnostic-only version of Norton Disk Doctor. In addition, you get a simple Windows batch language (based on Wilson WindowWare's *Winbatch*). And because Windows won't allow direct access to your hard disk when you want to undo serious damage, you get a floppy disk with the same DOS versions of the Disk Doctor, unerase, unformat, and defragmenter programs that come in *The Norton Utilities*.

NOT FLAWLESS BUT STILL EXCELLENT

All these programs look like brilliant first drafts. Most are either unique or better than the competition, but all have flaws that need to be ironed out. The core of the package is Norton Desktop. It combines a fast, effective file manager with drag-and-drop printing, deleting, backup, and file viewing. You can remake its menus, modify its icons, and add applications to a launch menu that comes up whenever you click on the Windows system menu. (Watch out: Programs compiled with Turbo Pascal for Windows will probably crash when run from this option.)

You can use Norton Desktop with Quick Access, an improvement on Windows' Program Manager that lets you put program groups inside other groups, or even move groups and icons out of Quick Access's own window and onto the desktop. Both Norton Desktop and Quick Access are painfully slow to load: On one test system we tried, Quick Access took six times as long as the Windows Program Manager, although a system with only one or two program groups loaded much faster.

You have to arrange Norton Desktop's icons by hand if you change the defaults, and Quick Access litters your disk with files that you can't easily move into a single directory for better housekeeping.

Norton Desktop's built-in file manager displays drive icons that you click on to display directories and files. You can sort and filter the file lists in almost any imaginable way, and you can zero in on a filename in a list by typing enough of the name to make a match; other Windows

DISK UTILITIES: SUMMARY OF FEATURES

Products listed in alphabetical order

	The Norton Desktop for Windows	The Norton Utilities	PC Tools
List price	$149	$179	$179
FILE AND EDITING FEATURES			
Text editor	❑	❑	■
Sector editor	❑	■	■
Partition editor	❑	■	❑
File attribute editor	■	■	■
File finder	■	■	■
Text finder	■	■	■
Allows editing within text finder	■	❑	❑
Data file compression and decompression	❑	❑	■
Executable file compression and decompression	❑	❑	■
Extended filename creation	❑	■	❑
Number of file viewers	30	None	37
Spreadsheet file viewers	■	❑	■
File fixer for damaged .WK* files	❑	■	■
File fixer for damaged .DBF files	❑	■	■
UNERASE			
Quick unerase (last file unerase)	■	■	■
User can view erased files in native format	■	❑	■
Partial recovery of overwritten files	■	■	■
Recovery of erased files on a network drive	■	■	■
Recovery of erased files from a removed directory	■	■	■
Recovery of removed subdirectory	■	■	■
Microsoft Windows–specific unerase module	■	❑	■
DIRECTORY FEATURES			
Sorts directories	■	■	■
Removes directories (pruning)	■	■	■
Renames directories	■	■	■
Moves files between directories	■	■	■
Presents visual tree	■	■	■
DISK FEATURES			
Defect analysis	■	■	■
Reformat recovery	■	■	■
Defragmenting	■	■	■
Disk mapping	■	■	■
Backup	■	❑	■
Benchmark tests	■	■	■
Format conversion	❑	❑	❑
Caching	❑	■	■

—Editors' Choice ■—Yes ❑—No

CONTINUES

FACT FILE

***The Norton Desktop for Windows*, Version 1.0**
Symantec Corp., 10210 Torre Rd., Cupertino, CA 95014; 800-441-7234, 408-252-3570.
List Price: $149.
Requires: 1MB RAM (3MB recommended), 5.5MB disk space for full installation, Microsoft Windows 3.0 or later, DOS 3.1 or later.
In Short: *The Norton Desktop for Windows* is the first full-scale package of Microsoft Windows utilities. It contains well-designed but slow-loading replacements for Program Manager and File Manager, a backup program, and other desktop conveniences. The package also includes a disk with the major rescue-and-repair programs from the DOS-based *Norton Utilities*.

CIRCLE 396 ON READER SERVICE CARD

DISK UTILITIES: SUMMARY OF FEATURES

Products listed in alphabetical order

	The Norton Desktop for Windows	The Norton Utilities	PC Tools
DISK FEATURES (continued)			
Damaged disk and partition table restoration	■	■	■
Low-level formatting	❑	■	■
Interleave adjustment	❑	■	■
Automatic disk repair	❑	■	■
DESKTOP UTILITIES			
Alarm clock	■	❑	■
Calculator	■	❑	■
Calendar	❑	❑	■
Clock	■	❑	❑
Fax board support	❑	❑	■
Macro editor	■	■	■
Notepad	■	❑	■
Outliner	❑	❑	■
Screen blanker	■	❑	■
Workgroup calendar	❑	❑	■
MEMORY MANAGEMENT			
Memory mapping	■	■	■
Uses LIM EMS 4.0 memory	❑	■	■
Saves RAM image to disk	❑	■	■
Produces extended and expanded memory reports	■	■	■
APPLICATIONS MANAGEMENT			
Applications launcher	■	■	■
Copy-protection removal	❑	❑	❑
Keyboard macros	❑	■	■
SECURITY FEATURES			
File encryption and decryption	❑	■	■
Password protection	■	■	■
Antivirus features	❑	■	■
Can wipe out files permanently	■	■	■
PRINTER MANAGEMENT			
Printer setups	■	❑	❑
LPT port adjustment	❑	❑	❑
REMOTE COMPUTING			
Supports remote computing by modem	❑	❑	■
Supports remote computing over a LAN	❑	❑	■
Supports direct-connect remote computing	❑	❑	■

—Editors' Choice ■—Yes ❑—No

programs only match the first letter.

You can move or copy single or multiple files by dragging icons, and you can drag a file to a printer icon and print it without explicitly running the application that created it. One design flaw: You can't easily see directory statistics.

A viewer lets you browse quickly through word processing, database, and spreadsheet files in most standard formats (but not *Lotus 1-2-3*, Release 3.*x*), or through common bitmapped graphics. If you try to view a *WordPerfect* graphics vector image, you get a misleading error message because the viewer supports only the rarely used bitmapped .WPG format. The manual says you can view compressed files, but you can view only their directories. Both viewer and file manager let you open and iconize multiple windows on the same screen.

FULL SET OF DESKTOP UTILITIES

The package's Desktop Utilities, which you can run either under Norton Desktop or separately, justify their slow loading by their ability to enhance Windows. A font display program lets you select characters from any font and copy them into an application—but you also have to se-

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The New York Times

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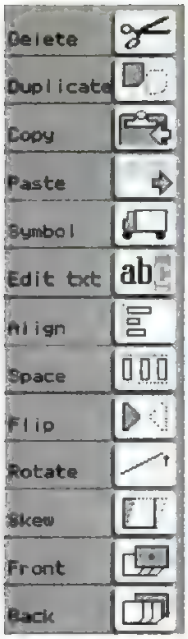
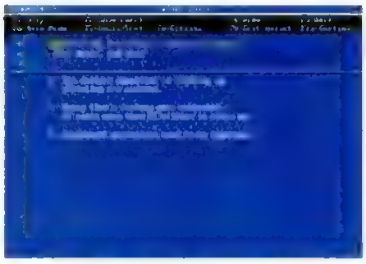
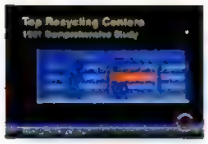


Drawing tools. 39 in all.

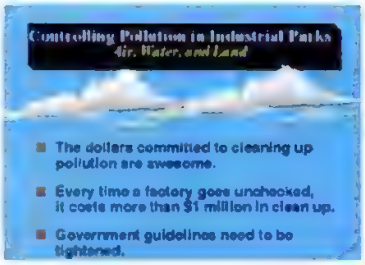


Do what you've always done before...

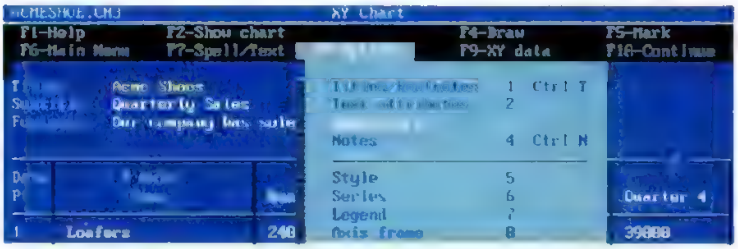
Twist it. Turn it.



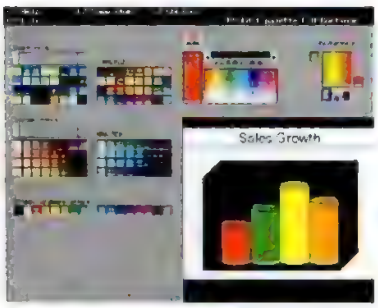
From titles to footnotes. From colors to logos. Our global options keep it consistent.



...style it like you've never seen before.



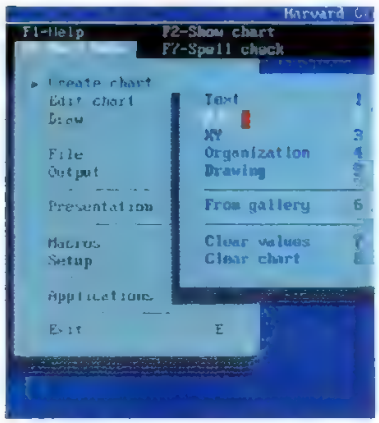
Pull-down menus: A new feature to get at the features. Easier than ever.



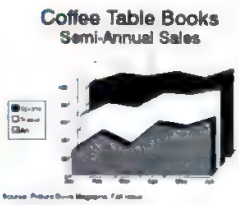
Choose from 32 color palettes. Then shade. Mix. Blend.

You enter the data, we'll make it look good. It's what you've known us for all along.

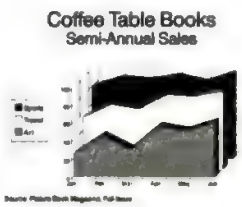
How do 16 million colors sound?



Look familiar? It should. It's Harvard Graphics.



What you see is what you get.



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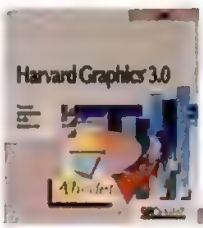

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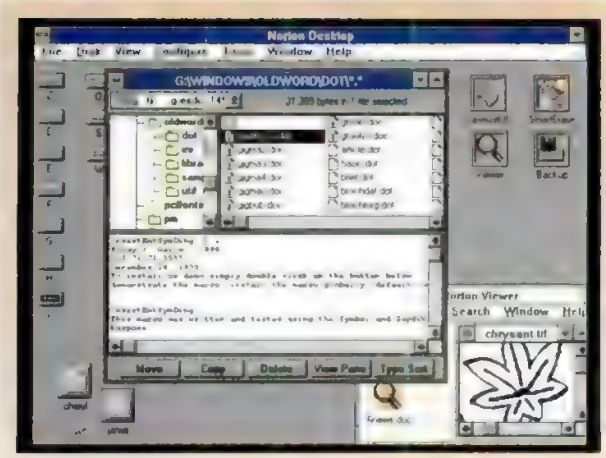
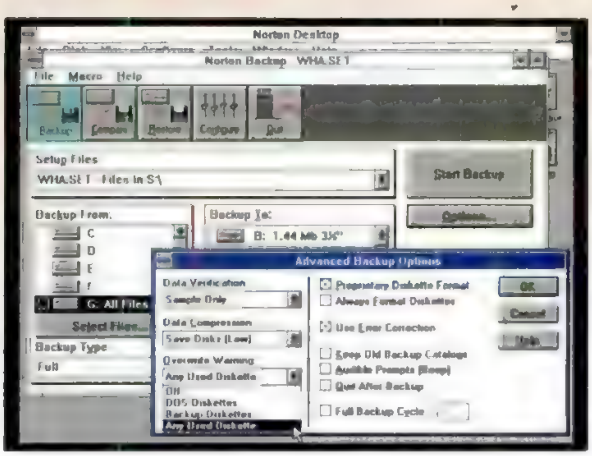


The Norton Desktop for Windows, Version 1.0, lets you drag file icons to icons for viewing, printing, backing up, or erasing. If you use *Adobe Type Manager*, the viewer uses a small text font that lets you see just enough of a file to make sense of its contents.



The Norton Desktop for Windows backup program uses clear menus for choosing options, which include advanced options hidden deeply enough to be overlooked by beginners. The file-selection screen is busier and more confusing.

lect the same font in your application, an inconvenience that Symantec says will be fixed in a future version.

A scheduler runs applications or pops up reminders at any regular interval. *Desktop for Windows*' icon editor is smart enough to extract icons from applications. The screen blanker (with passwords) looks better than many standalone counterparts. You get an advanced calculator and a system information program. Help for all programs includes small-scale illustrations for easy access to the details you need.

The disk and file utilities in Norton Desktop are better-looking counterparts of programs in the standard *Norton Utilities* package, some with added features, some with fewer. Unlike the DOS version of *Norton*'s Unerase (included in the Windows package's emergency disk), the Windows-based Unerase won't let you reconstruct files manually from lost fragments, but like the DOS version, it can work with a TSR that warehouses deleted files in a hidden directory. A Windows file shredder has the same function as the DOS file wipe program, killing the file forever.

Desktop for Windows' file finder lets you search for text through predefined groups of files, and a viewer pane lets you read matching files in native formats. But if you want to view a search "hit" in context, you have to open *Desktop for Windows*' separate viewer—and then you may not find the hit on-screen, because the viewer won't adjust the display to bring the hit within the window borders.

The Windows version of the DOS-based *Norton Backup* has a slightly confusing interface compared with *PC Tools*' Windows backup program, but both *PC Tools*' and *Norton*'s programs work at identical speeds in informal tests, and may have reached the practical speed limit in backing up to floppy disks. *Desktop for Windows* won't back up to tape drives until a future version appears.

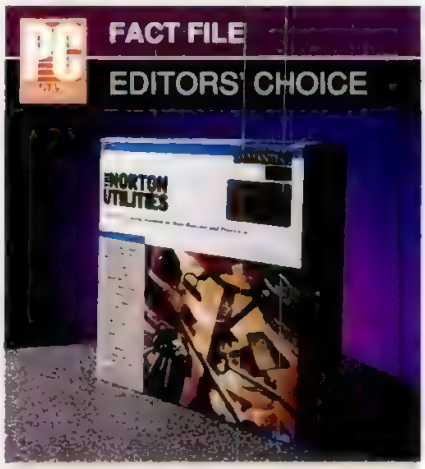
If you use *PC Tools*' cache program, *Desktop for Windows*' backup program thinks you haven't changed floppy disks when you actually have. Symantec's technical support has a fix that requires a minor change in an .INI file.

The installation offers plenty of options, but (like *PC Tools*) the package pushes itself to the head of your PATH command. *The Norton Utilities* considerately goes to the end of the PATH.

The Norton Desktop for Windows far surpasses all other Windows utility packages in its range of functions and in the ambition and audacity of its design. It's slower than it should be, it has some surprisingly rough edges, and its file and disk utilities are partly hobbled by Windows itself. Some of the utilities seem more like luxuries than necessities, but once you've used *The Norton Desktop for Windows*' file manager, viewer, and file finder, you may wonder how you managed to use Windows without them.

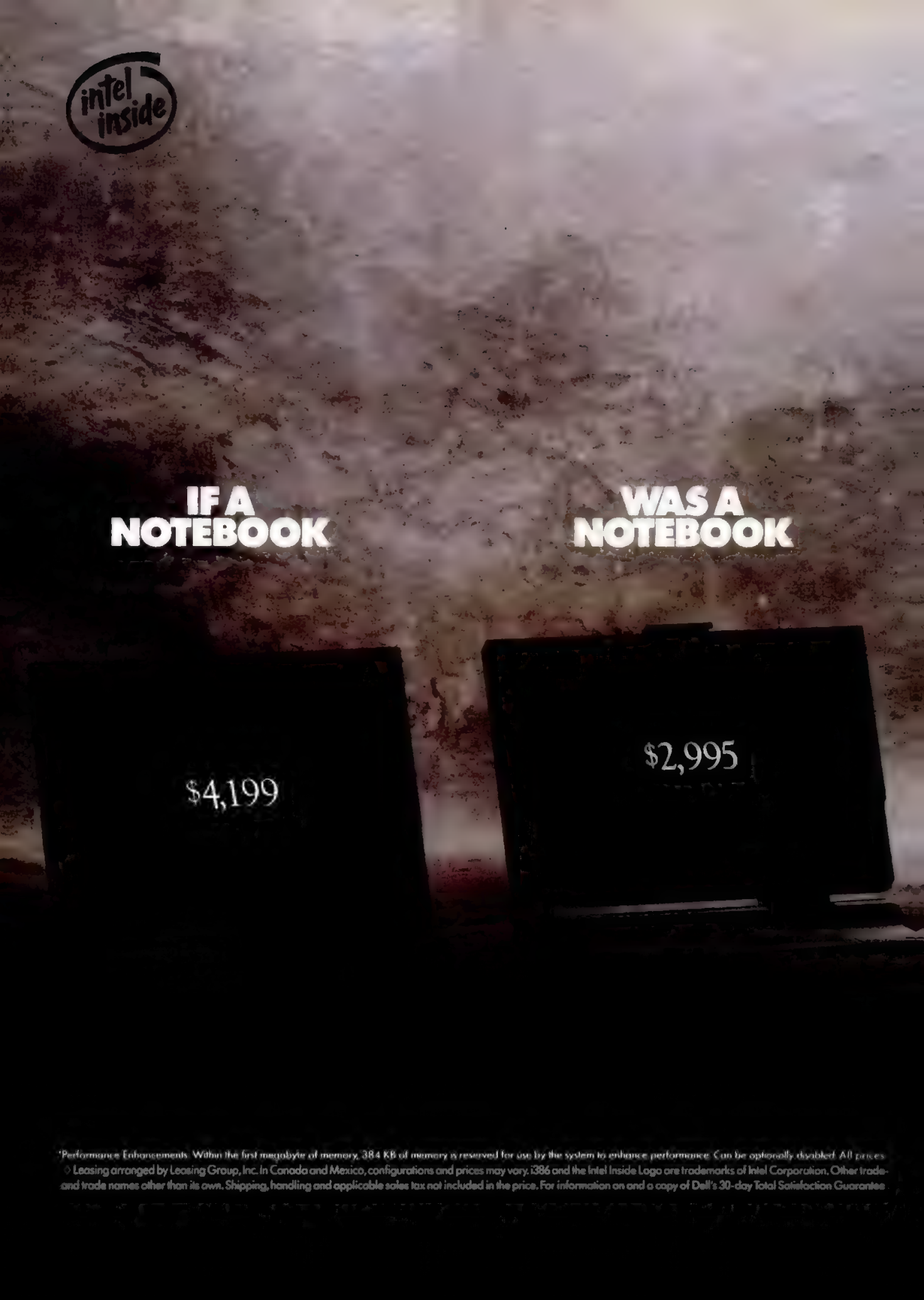
The Norton Utilities

A true classic always stays up to date. The original *Norton Utilities* virtually created the category of DOS utilities in the early 1980s, and now the disk and file utilities in Version 6.01 of Symantec's $179 package have the strength and flexibility necessary to cope with the massive, complex



***The Norton Utilities*, Version 6.01**
Symantec Corp., 10210 Torre Rd., Cupertino, CA 95014; 800-441-7234, 408-252-3570.
List Price: $179; upgrade, $39.
Requires: 512K RAM, DOS 2.0 or later.
In Short: *The Norton Utilities*' solidity and reliability continue to make it an indispensable package of disk and file utilities, complete with the only true serious sector editor on the market. Version 6.01 contains a COMMAND .COM replacement that lets expert users add luxuries and shortcuts that should have been part of DOS.

CIRCLE 307 ON READER SERVICE CARD



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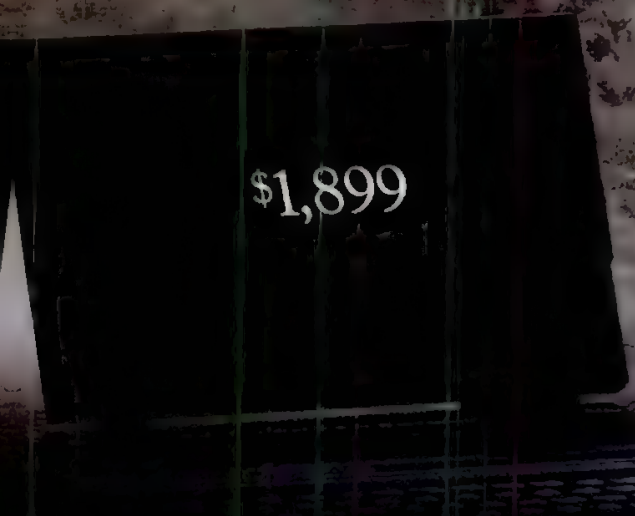

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CIRCLE 480 ON READER SERVICE CARD

HOW DOS 5.0 COMPARES WITH THE DATA RECOVERY UTILITIES

by Edward Mendelson

If you believe the wildly excessive coverage presented by the computer press, you may think the new utilities in DOS 5.0 eliminate any need for add-on utilities like those included in *PC Tools* or either *Norton* package. It's true that DOS 5.0 does more to preserve data than any earlier version, but files protected only by DOS 5.0 remain substantially less secure than files protected by third-party programs.

DOS 5.0 itself has nothing that corresponds to Norton Disk Doctor or *PC Tools*' DiskFix—two programs that automatically undo extensive damage to file allocation tables (FATs) and directories, and can restore access to disks that DOS doesn't recognize at all. DOS's CHKDSK tries to fix FAT damage but can't approach these two programs in intelligence or power. And DOS's archaic RECOVER command is so dangerous that you should wipe it from your disk to prevent using it by mistake. DOS 5.0 also lacks *Norton*'s and *PC Tools*' defragmenting programs, which make it easier for other protection programs to restore deleted files.

DOS 5.0's PC TOOLS HERITAGE

DOS 5.0 has three valuable protection programs—Mirror, Undelete, and Unformat—that are derived from the similar programs in *PC Tools*, Version 6.0 (the current version is 7.1). DOS 5.0's safe and reversible FORMAT .COM also derives from *PC Tools*. Here's what DOS 5.0's programs can and can't do, compared with third-party packages:

Before you start deleting files, you can run DOS 5.0's Mirror program on all partitions. This saves a copy of the FAT and root directory for later use by Undelete and Unformat. An optional switch lets you load Mirror's delete-tracking TSR, which stores the location of the clusters of deleted files. The essential syntax is

```
mirror d: d: ... /td /td ...
```

where *d:* is name of a drive whose FAT and root directory you want to store, and the *d* in */td* is the name of a drive whose files you want the TSR to track when they're deleted.

Norton packages can use Mirror and delete-tracking data, but their Image program is much faster than Mirror. *Norton*'s Image doesn't have delete-tracking, but *Norton* has a separate Erase Protect TSR that stores the data in deleted files instead of merely recording its location and letting you hope it won't be overwritten. *PC Tools* has an updated version of Mirror and uses a separate Diskmon program for both delete-tracking and *Norton*-style storage of deleted files.

Like similar utilities in *Norton* and *PC Tools*, DOS 5.0's Mirror can save a copy of a hard disk's partition table.

DOS 5.0's Undelete is a command-line-only program that uses Mirror and delete-tracking data if it finds any. Unlike *Norton* and *PC Tools*, DOS 5.0 can't recover subdirectories or files in deleted subdirectories and has no easy-to-use menu-driven interface that lets you rebuild files by searching the disk for lost data.

The recovery features in DOS 5.0's Unformat are essentially the same as those in programs in *Norton* and *PC Tools*, especially if you've recently run Mirror or Image. If you haven't run either, and the unformatter has to use the brute-force method of scanning a disk for data and files, *PC Tools*' Unformat gives you options you don't get in *Norton* or DOS for handling fragmented files.

DOS 5.0's command line Format program, like the command line or menu-driven versions in *Norton* and *PC Tools*, now allows reversible formats and quick formats of already formatted floppy disks. One safety feature made possible by DOS 5.0's DOSKEY is a modification for DOS's trigger-happy DEL command. Use DOSKEY to create an alias for DEL that causes DEL to let you think twice before erasing any file. The syntax is as follows:

```
DOSkey del=del $1 /p
```

Once DOSKEY is loaded, when you next type DEL *.DOC, this alias adds DEL's /p parameter, and you'll be prompted before each deletion. ■

files and disks of the 1990s.

When you buy *Norton* you get the most advanced and the most carefully designed disk repair and organization utilities available for the PC. All of these tools—including a disk editor, defragmenter, cache, directory sorter, file finder, and formatter—are effective and fast. *Norton*'s quick directory changer now includes directory prune-and-graft when you run it at full-screen size. You also get *Norton*'s usual variety of smaller programs, including utilities that wipe data from a disk, warehouse deleted files, encrypt files on the fly, control access to a disk, repair damaged spreadsheet and database files, and add features to batch files. Most work equally well from Alt-key menus and from the command line, and some command-line-only utilities that had been dropped from Version 5.0 are back by popular demand. All TSRs in the package can load in high memory.

DiskEdit (DE), the latest incarnation of the original *Norton* program for exploring and editing files and disks, is one of the most important parts of the package and has no serious competition. It lets you edit files, directories, file allocation tables (FATs), and partition tables. A split screen lets you edit a file in one window and its directory entry in the other or put the two copies of the FAT in different Windows and transfer data between them.

DE lets you modify regions of a disk that few other programs dare to look at, and makes disk editing simpler and safer than any other program on the market. In months of heavy use we found only one minor flaw in its design: If you hold down the Spacebar to blank out text in the hexadecimal-edit screen, you'll eventually bring up a dialog box that asks if you want to Write or Discard your changes, and another tap on the Spacebar selects Write.

You should at least have to press Enter to make changes to your disk.

Norton's Unerase runs from the command line or full-screen, and it automatically uses the most recent image of the FAT and root directory stored in either *Norton*'s own Image file or the Mirror file created by DOS 5.0 or *PC Tools;* if you have both files, you can specify which one to use. Unerase can help recover deleted file fragments by searching quickly and effectively for *dBASE,* spreadsheet, or text formats in erased areas on the disk.

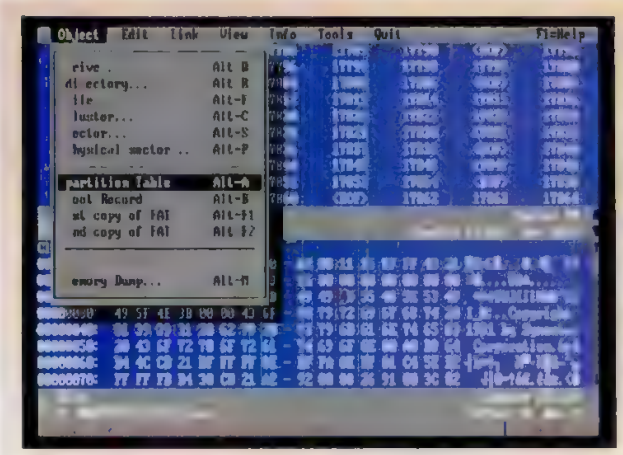
Norton recovered long-deleted *dBASE* and *Lotus 1-2-3* files with a few keystrokes by identifying the format of their clusters. When faced with the same task, *PC Tools* forced us through extensive manual scanning of possible clusters before it let us recover the files, and even then it only recovered half of the *1-2-3* file. Unlike *PC Tools, Norton* won't display *dBASE* or spreadsheet files in their native format, but it will recover them automatically where *PC Tools* won't.

The main weakness of *Norton*'s Unerase is its failure to work correctly on a SUBST drive (SUBST is the DOS command that lets you access a subdirectory as if it were a separate drive with its own drive letter). If you tell it a SUBST pathname when asking to recover a file, it responds that it can't recover any deleted files. If you ask it to recover the same file under the true DOS pathname, it recovers the data instantly. *PC Tools* handles SUBST drives easily.

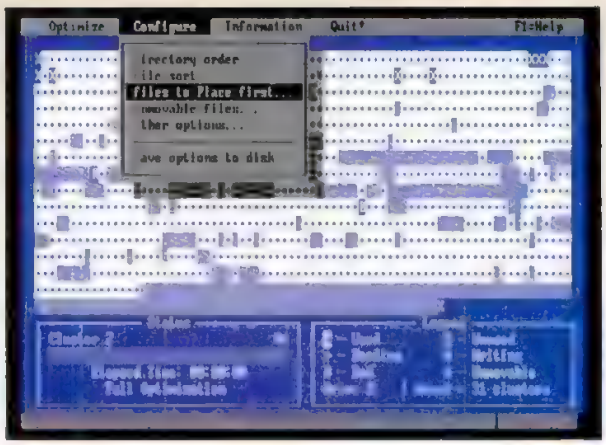
Norton Disk Doctor (NDD) and *PC Tools*' DiskFix seem about equal in their ability to restore your disk after major and minor disasters, with *Norton* slightly ahead in special cases. On our tests, NDD recognized and successfully repaired all circular cluster chains and similar FAT problems that could conceivably be fixed; DiskFix simply ignored one circular FAT chain that *Norton* repaired.

SLICK DEFRAGGING

Norton lets you create a rescue disk with copies of your CMOS, partition table, and boot record, but you have to create the disk by digging down into the menus, and the disk doesn't include the *Norton* programs needed to use the copies. Expert users will add these manually, but many users won't bother to create a rescue disk at all. In contrast, *PC Tools* creates a full self-contained rescue disk during installation so you'll have it when you need it.



The DiskEdit program in *The Norton Utilities,* Version 6.01, is the only hexadecimal editing program that gives you split-screen editing and direct access to the partition table. If you run the program in its maintenance mode, it even gives you access to a hard disk's diagnostic cylinder.



The SpeedDisk defragmenter, like most utilities in *The Norton Utilities,* keeps options clearly sorted among its menus. If you choose the Files to Place First option as shown, you can easily edit the file list you create.

Norton's disk tester and non destructive low-level formatter, Calibrate, resembles Gibson Research's *Spinrite II* but has a far cleaner interface. Like most programs of this type, it can low-level-format only low-tech MFM and RLL hard disks, not IDE, SCSI, or most ESDI drives—although it performs intensive tests on all disks.

Until Version 6.0, *The Norton Utilities* offered disk utilities and little else, but the package now includes NDOS, a replacement for COMMAND.COM that offers all the conveniences DOS doesn't, including a full-screen selection of files to use with any command, automated feeding of keystrokes to applications, and file associations (as in Windows) that run applications when you enter the name of a data file. Expert users will find endless riches in NDOS. You don't need NDOS to use the traditional *Norton* programs, but its vast superiority over COMMAND .COM makes it almost irresistible. NDOS benefits from three years of real-world testing and development as the shareware product *4DOS* from JP Software. Its only serious quirk, which may annoy users too impatient to read the manual, occurs when DOS's FORMAT /S runs under NDOS and you discover that the resulting disk isn't bootable.

Symantec sent a minor bug fix, Version 6.01, to registered users a few months after the release of Version 6.0, but the later version still has some small weaknesses. The file finder, which can't display files in their native format, saves

Suitability to Task

The Norton Utilities

Data recovery	4
Disk and file management	4
Applications management	2
Desktop utilities	N/A

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The four-digit number next to each product is the product's ITEM NUMBER. Please refer to this number when ordering. Thank you.

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4090 ▣SuperStor 1.3 ..... $83.
Adobe Systems ... NCP
7547 ▣Adobe Type Manager 1.1 for Windows . 69
9623 ▣Adobe TypeAlign 1.0 for Windows 69
▣Adobe TypeSets for Business..... ea. 95
9874 ▣Adobe TypeAlign 1.0 w/ATM..... 125.
7928 ▣Adobe Plus Pack 1.0..... 129
8367 ▣ATM & Plus Pack Bundle..... 169.
7392 ▣Adobe PostScript Cartridge *(with choice of FREE Type Cartridge 1 or Type Cartridge 2)* 299.
(Entire Adobe Type Library, from 1 to 240 is available. Call for more information.)
Aldus ... NCP
6000 ☐Persuasion 2.0 for Windows ..... 359.
1332 ☐PageMaker 4.0..... 549.
4195 ☐Photostyler 1 0 ..... 549.
Application Techniques ... NCP
1214 ▣Pizazz Plus 2.0 ..... 69.
9621 ▣Picture Eze 1.0 for Windows..... 99.
Artisoft ... NCP
2455 Lantastic EtherNet Starter Kit *(includes software, 2 EtherNet cards, cable)* ..... 495.
2452 EtherNet Adapter Card ..... 209.
Atech Software ... NCP
9436 ☐Publisher's Powerpak 1.2 for Windows . 49.
9435 ☐Publisher's Powerpak 2.1 for WordPerfect & Microsoft Word ..... 49.

AddStor ... NCP
4090 ▣*SuperStor 1.3*—Increase your disk space 2-3 times and compress data on floppies and external media. Easy installation and use, with no artificial DOS commands. Completely data safe and transparent..... $83.

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8846 ▣WideAngle 2.0 ..... $79.
Automap ... NCP
2729 ☐Automap 1.0..... 52.
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6006 ▣Label Pro 1.0 *(Laser)*..... 49.
7336 ▣Label Pro 1.0 for Dot Matrix ..... 49.
1600 Avery 1st Impression ..... 229.
Banner Blue Software ... NCP
3322 ▣Family Tree Maker 2.0..... 45.
3324 ▣Org Plus Advanced 6.0..... 65.
Berkeley Systems ... NCP
9885 ▣After Dark 1 0A for Windows..... 29.
Bitstream ... NCP
7568 ▣FaceLift 1.2 for Windows 2.x/3.0..... 59
8040 ▣FaceLift 1.5 for WordPerfect 5.0/5.1 ... 59.
7569 ▣Companion Value Pack 1.0..... 125.
8883 ▣Type City Cartridge with Dell..... 259.
▣Typeface Packages ..... ea. 89.
Borland International ... NCP
6242 ▣Quattro Pro 3.0..... 339.
9695 ☐Borland's C++ 2.0..... 339.
1514 ▣Paradox 3.5 ..... 529.
9635 ▣Object Vision 1.0 ..... call
Broderbund ... NCP
1434 ▣New Print Shop..... 39.
ButtonWare ... NCP
6419 ▣PC-File 6.0 ..... 89.

Automap ... NCP
2729 ☐*Automap 1.0*—An intelligent PC road atlas! Provides hundreds of color maps showing over 359,000 miles of U.S. highways & roads. Print driving instructions & view information on 51,921 cities & points of interest $52.

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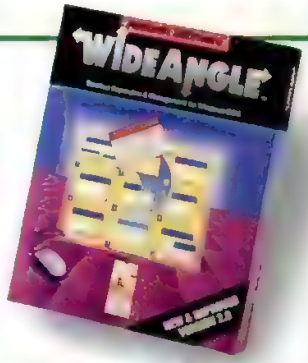
8933 ▣Omnipage Professional 1.0 669.
Central Point ... NCP
5039 ☐PC Tools 7.1 ..... 115.
8114 ▣Backup 7.0 *(DOS and Windows)* ..... 84.
9751 ▣AntiVirus 1.0..... 84.
Chipsoft ... NCP
1663 ▣Turbo Tax Personal 1040 for DOS 9.0 .. 49.
3517 ▣Turbo Tax Personal 1040 for Windows 2.0 59.
State Tax Packages
DOS ver... ea. 38. Windows ver... ea. 49.
▣ShortForm *(for 1040 & E-Z filers)*
3788 DOS ver.... 25. 3782 Windows vers.... 33.
Chronologic Corporation ... NCP
8849 ▣Instant Recall 1.2 ..... 64.
CompuServe ... NCP
7546 ▣DOS Membership Kit 1.3 ..... 29.
Concentric Data Systems ... NCP
6575 ▣R & R Relational Report Writer 4.0.... 159.
Corel Systems ... NCP
5506 ☐CorelDRAW! 2.0..... 379.
2618 CorelDRAW! 2.0 CD-ROM ..... 449.
DAC Easy ... NCP
1748 ▣Accounting 4.2..... 99.
1751 ▣Bonus Pack 4.2 ..... 135.
Data Storm ... NCP
4798 ▣PROCOMM PLUS 2.01 ..... 69.
Delrina Technology ... NCP
2446 ▣WinFaxPro 2.0 ..... 75.
7351 ▣PerFORMPRO 1.0 179



Attitash Software ... NCP
8846 ▣*WideAngle 2.0*—Eliminates overlapping windows by spreading programs into one of nine screen-sized workspaces. Simplifies access to DOS applications. XRAY View 'sees through' windows clutter..... $79.

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8288 ☐DR DOS 6.0 ..... 69.
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3950 ▣Fastback Plus 3.0 ..... 125.
7795 ▣Disklock 1.0 ..... 129.
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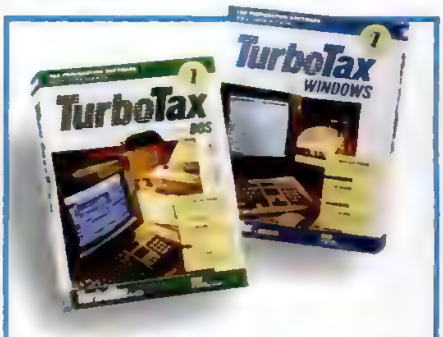
6188 ⊡FoxPro 2.0 ..... 489.
Funk Software ... NCP
9488 ▣Sideways 3.3 & P.D. Queue 1.0..... 85.
Geoworks ... NCP
8789 ▣Ensemble 1.2 ..... 129.
Gibson Research ... NCP
9832 ▣SpinRite II 2.0 ..... 64.
Great American Software ... NCP
3978 ☐One-Write Plus Accounting 1.0 *(with free MECA TaxCut)* ..... 105.
4880 ☐One Write Plus Acct. Works 1.0..... 189.
hDC Computer Corporation ... NCP
8974 ▣Icon Designer 1.0 ..... 35.
Helix Software ... NCP
9627 ▣Netroom 2.0 *(single user)* ..... 65.
Hilgraeve ... NCP
8204 ▣HyperACCESS/5 2.0 *(DOS)* ..... 59.
IBM ... NCP
2666 ☐DOS 5.0 Upgrade ..... 59.
Individual Software ... NCP
1328 ▣Professor Windows 1 0 ..... 27.
6222 ▣Resume Maker 1.3..... 29.
Inset Systems ... NCP
7298 ▣HiJaak 2.1 ..... 99.
7300 ▣Inset Plus HiJaak ..... 125.



Chipsoft ... NCP
▣*Turbo Tax Personal 1040 for 1991 (Final edition)*—Everything you need; features over 80 forms, schedules & worksheets plus a tax planning module. Prints IRS-approved returns.
1663 *DOS*.... $49. 3517 *Windows* $59.

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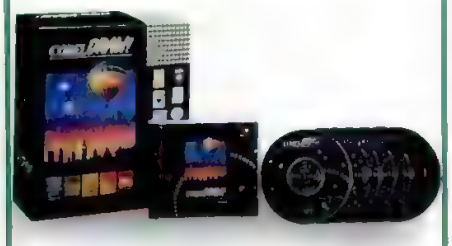
5596 ☒ Quicken for Windows ..... 45.
2474 ☒ Quicken with QuickPay ..... 75.

LaserTools ... NCP
6882 ☒ PrintCache 2.4 ..... 99.
2656 ☒ Printer Control Panel 2.2 ..... 99.

Lotus ... NCP
5417 ☐ 1-2-3 3.1 Plus ..... 429.
5653 ☐ 1-2-3 2.3 ..... 349.
1852 ☐ 1-2-3 2.3 Upgrade ..... 95.
2755 ☐ 1-2-3 for Windows 1.0 399
5799 ☒ Ami Pro 2.0 299
1847 ☒ Ami Pro Competitive Upgrade 119
1621 ☐ Freelance Graphics 4.0 for DOS ..... 349.
3523 ☒ Freelance for Windows 1.0 ..... 429.
2750 ☒ cc:mail DOS Platform Pack ..... 125.
2748 ☒ cc:mail Windows Platform Pack ..... 325.
2749 ☒ cc:mail 25 user Pack ..... 379.

MacroMind ... NCP
3484 Action! 1.0 *(3½" only)* 349

M-USA Business Systems ... NCP
3408 ☒ Pacioli 2000 *(Accounting software)* ..... 35.



Corel Systems ... NCP
5506 ☐ *CorelDRAW! 2.0*—"CorelDRAW 2.0 is worth every penny. Special effects can even turn inexperienced artists into master draftsmen," Luisa Simone of *PC Magazine* ... $379.
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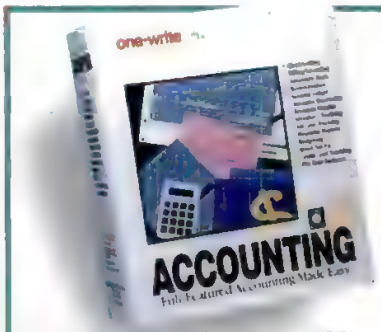
4408 ☒ Micro Courier 1.0 ..... 59.
7649 ☒ Virex-PC 2.0 ..... 79.
6234 ☒ CarbonCopy Plus 6.0 ..... 119.

Microlytics ... NCP
9636 ☒ Strunk & White Elements of Style 1.0 ... 35.
7931 ☐ Random House Encyclopedia 1.0 ..... 68.

Microsoft ... NCP
3338 ☐ Money 1.0 for Windows 49
2894 ☐ QuickBasic 4.5 ..... 69.
7010 ☐ Windows 3.0 99
7388 ☒ Project 1.0 for Windows ..... 459.
2904 ☐ Works 2.0 ..... 99.
2735 ☒ Works 1.0 for Windows 139
3337 ☒ Publisher 1.0 for Windows 139
2901 ☐ Word 5.5 ..... 209.
7387 ☒ PowerPoint 2.0 for Windows ..... 319.
6195 ☒ Word 2.0 for Windows ..... 329.
2856 ☒ Excel 3.0 for Windows 329
8137 ☐ Office 1.6 for Windows ..... 499.
1620 ☐ DOS 5.0 Upgrade ..... 65.
1624 ☒ Visual Basic 1.0 ..... 139.

Multisoft ... NCP
4925 ☒ PC-Kwik Power Pak 2.1 ..... 75.



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3978 ☐ *One-Write Plus Accounting 1.0*—New! Includes General Ledger with Checks & Receipts, Accounts Receivable with Invoicing, & Accounts Payable. Now also includes a free copy of MECA's TaxCut (limited time) . $105.

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2982 ☒ WillMaker 4.0 ..... 39.

Norton-Lambert ... NCP
2753 ☐ CloseUp for Windows & DOS Dual Pack 129.

Novell ... NCP
4000 ☐ Netware Lite 1.0 ..... 69.

Okna ... NCP
9696 ☒ Desktop Set 3.0 for Windows ..... 85.

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5900 ☒ PC USA 2.0 ..... 35.

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9288 Laptop Ultravision 2.1 *(3½" only)* ..... 49.
4384 ☒ Ultravision 2.0 ..... 79.

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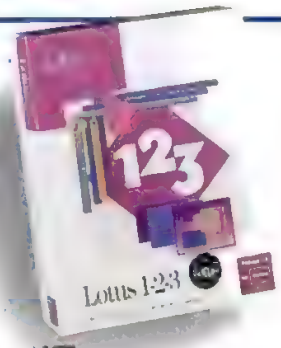

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2755 ☐ *1-2-3 for Windows*—Includes all the latest 1-2-3 enhancements (3D worksheets, goal-seeking, etc.) as well as SmartIcons, DDE, and a complete Windows graphical environment. Compatible with all 1-2-3 versions .... $399.

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7857 ☒ Labels Unlimited 3.0 ..... 59.
7858 ☒ Express Publisher 2.0 ..... 99.

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7539 ☐ 386MAX 6.0 ..... 65.
7967 BlueMAX 6.0 for PS/2 *(3½" only)* ..... 85.

Quarterdeck ... NCP
3221 ☐ Expanded Memory Mgr. 386 6.0 ..... 65.
4586 ☐ DESQView 386 2.4 ..... 145.

QUE Software ... NCP
4155 ☒ RightWriter 4.0 ..... 54.

Reality Technologies ... NCP
7891 ☒ WealthStarter 2.0 w/Charles J. Givens .. 39.
6572 ☒ WealthBuilder 1.1 ..... 99.

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4396 ☒ Grammatik IV 2.0 ..... 59.
7483 ☒ Grammatik for Windows 2.0 ..... 59.

Roykore ... NCP
2473 ☒ Instant ORG Charting! 1.0 ..... 125.
8162 ☒ ABC Flowcharter 1.1 ..... 189.

Sitka ... NCP
6675 ☐ TOPS Network Bundle 3.0 ..... 159.
3720 Flashcard 2.1 *(AppleTalk network card)* . 155.

Softlogic Solutions ... NCP
3542 ☐ Software Carousel 5.0 ..... 55.

Software Publishing ... NCP
3496 ☐ Professional Write 2.2 ..... 169.
9638 ☐ Professional Write Plus 1.0 ..... 169.
4389 ☐ Harvard Draw 1.0 ..... 419.
3482 ☐ Harvard Graphics 3.0 ..... 419.
4403 ☐ Harvard Graphics 1.0 for Windows ... 399
6600 ☒ Superbase 4 for Windows 1.3 ..... 529.

Software Toolworks ... NCP
9859 ☒ Word for Word 4.2 for Windows ..... 47.
3290 ☒ Desk Reference Library ..... 45.

Software Ventures ... NCP
6889 ☒ MicroPhone II 2.0 99

Spinnaker ... NCP
1415 ☒ PFS: WindowWorks 1.0 129

Stac Electronics ... NCP
1409 ☒ Stacker 2.0 ..... 89.

Symantec ... NCP
6397 ☐ The Norton Backup 1.2 *(Windows/DOS)* 89.
3146 ☒ The Norton Utilities 6.0 ..... 119.
3425 ☐ Q&A 4.0 ..... 269.
7999 ☒ Norton Anti-Virus 1.5 ..... 89.
2359 ☐ The Norton Desktop 1.0 for Windows 99.
8378 ☐ PC Anywhere IV 4.03 ..... 125.

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4411 ▣ *SimEarth for Windows from Maxis*—New! Take charge of a planet from its birth by controlling its geosphere, atmosphere, biosphere, and civilizations. Unleash natural forces and build your own paradise..... $45.

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3949 ☐Complete Writer's Toolkit 1.0 for Windows 85
6564 ☐Software Bridge 5.0 ..... 79.
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9847 ▣M Y O B for Windows 139
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1270 ☐TimeSheet Pro 2.0 ..... 135.
Timeworks ... NCP
6253 ▣Publish-It! 2.0 ..... 159.
Tool Technology ... NCP
3863 WinTools for Windows 1 0 *(3½" only)* 125.
Touchstone Software ... NCP
7420 ▣Check It 3.0 ..... 89.
Traveling Software ... NCP
5179 ▣LapLink III 3.0..... 95.
Venture ... NCP
7796 ▣Publisher V 4 0 for Windows 569
WordPerfect Corporation ... NCP
7781 ▣LetterPerfect 1.0 ..... 129.
4214 ▣WordPerfect Office PC ..... 89.
3804 ☐WordPerfect 5.1 ..... 265.
3494 ☐WordPerfect 5 1 for Windows 279
3806 ☐WordPerfect 5 1 Additional User 199
WordStar International ... NCP
1482 ▣Correct Grammar 1 0 for Windows 65
6791 ☐WordStar Professional 6.0..... 199.
XTREE ... NCP
6161 ▣XTree Gold 2.5 ..... 95.
Z-Soft ... NCP
1626 ▣Publisher's Paintbrush for Windows .. 299.

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1836 ▣Where in America's Past is Carmen Sandiego ..... 39.
5851 ▣SimCity..... 33.
4411 ▣SimEarth for Windows from Maxis 45
Davidson & Assoc. ... NCP
3947 ▣Math Blaster Plus ..... 29.
4183 ▣KidWorks ..... 29.
EARTHQUEST ... NCP
3926 ▣EARTHQUEST ..... 35.
Electronic Arts ... NCP
4534 ▣Mavis Beacon Teaches Typing 2.0 *(CP)* 35.
3031 ▣Mavis Beacon for Windows 45
3023 ▣ChessMaster 3000 ..... 35.
1334 ☐Chuck Yeager Air Combat Trainer..... 42.
3050 ☐World Atlas for Windows 57
Harvard Associates ... NCP
2324 ▣PC Logo 3.0 ..... 59.
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(French, German, Italian, Spanish available.)
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☐Word Torture 3.0 ..... *ea.* 29.

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Personal Training Systems ... NCP
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2767 ☐Leisure Suit Larry V *(VGA)*..... 39.
9466 ☐Space Quest IV *(VGA)*..... 39.
3113 ☐Police Quest III *VGA)*..... 39.
Software Toolworks ... NCP
3294 ▣Game Pak *(5 games in one)* ..... 32.
Spectrum Holobyte ... NCP
3047 ▣Wordtris ..... 27.
3457 ☐Falcon 3.0 ..... 49.
Stone & Associates ... NCP
3435 ▣Letters, Numbers, Words ..... 22.
3439 ▣2nd Math 4.2 ..... 27.
Toyogo ... NCP
2701 ▣Go Master 5 0 for Windows . 39
2703 ▣Nemesis Deluxe Toolkit 5.0..... 75.
2704 ▣Nemesis Deluxe Toolkit 5.0 for Windows. 75.

Walt Disney Computer Software ... NCP
4398 ▣ *The Animation Studio*—Full-featured animation & paint program utilizing state-of-the-art techniques characteristic of Disney. Comes complete with four disks full of Disney animation, music, & sound effects ..... $79.

True BASIC, Inc. ... NCP
▣Kemeny/Kurtz Math Series ..... *ea.* 45.
Walt Disney Computer Software ... CP
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2624 ▣Mickey's ABC's ..... 35.
4398 ▣The Animation Studio ..... 79.

HARDWARE

Warranties listed next to manufacturer.

American Power ... 2 years
7108 Smart UPS 400 ..... 339.
7105 Smart UPS 600 ..... 469.
3858 Back-UPS 400 ..... 185.
3823 Back-UPS 600 ..... 299.
ATI Technologies ... 2 years
9821 VGA Basic-16 *(640 x 480, 16 colors)*..... 69.
2706 VGA Wonder XL *(w/1 MB)* ..... 239.
9985 VGA Integra *(1024 x 768, 16 colors)* ..... 95.
2382 Graphics Vantage VGA *(w/1 MB)* ..... 359.
9822 Graphics Ultra *(w/1 MB)*..... 559.
2012 Graphics Ultra w/VGA *(w/1 MB)* ..... 619.
1825 2400etc/i Modem *(w/9600 SendFax)* ... 139.
9620 9600etc/e Modem ..... 379.
3080 Stereo•F/X ..... 149.
3076 VGA Stereo•F/X *(w/512K, upgrd. to 1 MB)* 329.
Boca Research ... 5 years
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6998 I/O Board for AT ..... 55.
6999 I/O Board for Microchannel *(S/S/P)*..... 109.
8380 BasicVGA *(256K, 640 x 480)* ..... 63.
8381 SuperVGA *(1 MB, 1024 x 768)* ..... 145.
3859 2400 Internal Modem..... 85.
3860 2400 External Modem ..... 109.
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CH Products ... 1 year
7801 FlightStick w/Falcon..... 49.
CoStar ... 1 year
1418 AddressWriter Envelope Printer ..... 499.

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Polaris Software ... NCP
4395 PackRat 4.0–Increase productivity by easily managing your business and personal information. Handle your phone book, calendar, to-do's, projects, free-form notes and much more! ..... $255.

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7358 Command Center SPF-4 ..... 89.
Glass Filter Plus *(specify size)* ..... ea. 65.

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MATH COPROCESSORS
9875 FasMath 83D87-25 ..... 185.
9876 FasMath 83D87-33 ..... 195.
9877 FasMath 83S87-16 *(SX compatible)* ..... 115.

Datadesk ... 3 years
6901 Switchboard *(modular keyboard)* ..... 159.

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We are an authorized Epson Service Center.
1906 FX-850 *(80 col., 264 cps, 9 pin)* ..... 319.
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2358 LQ-570 *(80 col., 252 cps)* ..... 289.
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2357 LQ-1170 *(136 col., 330 cps)* ..... 669.
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1683 Tempo LX Notebook *(5 MB, 60 MB HD)* 2549.

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9884 Pocket Edition 2400 ..... 125.

Hewlett-Packard ... 1 year
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9993 LaserJet IIIP *(with toner)* ..... 1149.
6754 LaserJet III *(with toner)* ..... 1679.

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Intel ... 5 years
3864 14.4EX Modem ..... 549.
6421 2400B MNP Internal Modem ..... 189.
6420 2400EX MNP Modem ..... 225.
7880 9600EX Modem ..... 469.
2346 Inboard 386/PC with 1 MB ..... 495.
5336 Above Board Plus 8 2 MB ..... 449.
5342 Above Board Plus 8 I/O 2 MB ..... 479.
7782 SatisFAXtion *(fax board)* ..... 389.
8778 SatisFAXtion for Microchannel ..... 449.
8903 Matched Memory 4 MB *(PS/2)* ..... 239.
Matched Memory *(for LaserJet IIP, III, IIIP IIID)*
1810 1 MB ..... 79. 1787 2 MB ..... 149.
1637 Snap-In 386 *(for PS/2 50/60)* ..... 389.
3358 Power Pak *(Snap-In 386 & Above Board Microchannel 4 MB)* ..... 925.

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7385 80287XL *(16 MHz 80286 CPU's)* ..... $89.
4750 80387SX *(16 MHz 80386SX CPU's)* ..... 129.
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5409 80387-33 *(80386DX CPU's)* ..... 219.

Kensington Microware ... 1 year
2582 Master Piece Plus ..... 99.
7899 Expert Mouse *serial* . 119. 7900 *bus* . 129.
3311 MasterStand ..... 59.

Key tronic ... 3 years
4518 101 Plus Keyboard ..... 99.

Kraft ... 5 years
5801 Game Card *(2 ports)* ..... 27.
5813 Game Card w/Thunderstick ..... 49.
5800 3 button Thunder Joystick ..... 29.

Logitech ... limited lifetime
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2343 Trackman Portable ..... 105.
7975 ScanMan 256 ..... 289.
3295 MouseMan *(combo)* 75. 9766 *(cordless)* 89.

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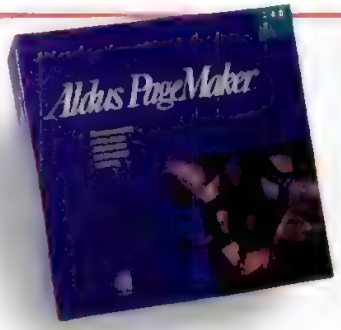

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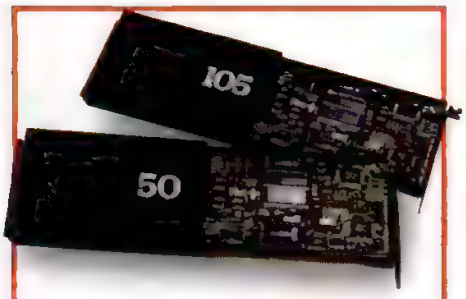

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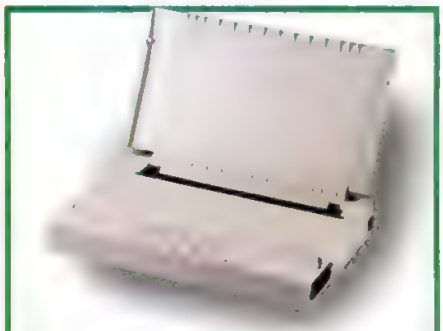

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WHEN SHOULD YOU LOOK BEYOND THE ALL-PURPOSE UTILITIES?

by Edward Mendelson

All-purpose utility packages like the three reviewed in this story don't always compete favorably against single-function utilities with specialized talents. *The Norton Utilities* and *PC Tools* give you disk caches and defragmenters, and *The Norton Desktop for Windows* and *PC Tools* both have backup programs and file managers. *PC Tools* also contains a remote-control program. How do all of these features compare with standalone packages that often cost as much as the full set of utilities you get with these combination packages?

DISK CACHES

Super PC-Kwik, from Multisoft (800-234-5945), is probably the fastest and most reliable program of its kind. It is now available in the *PC-Kwik Power Pak* along with a print spooler, RAM disk, screen accelerator, and other programs, many of which can share the same memory pool. Compared with *Super PC-Kwik*, *Norton*'s cache is bulkier and slower, but *PC Tools*' cache takes up less RAM and approaches *Super PC-Kwik* in speed. As reported elsewhere in this story, however, both the *Norton* and *PC Tools* cache programs can cause incompatibilities with other packages' backup programs, while *Super PC-Kwik* coexists peacefully with virtually everything.

DEFRAGMENTERS

The defragmenters in *The Norton Utilities* and *PC Tools* both have plenty of speed and options and are more than adequate for most practical purposes. But neither one offers the unmatched flexibility and control available in FastTrax International's *FastTrax* (415-883-9561). *FastTrax* lets you control every detail of file and directory locations, and it not only defragments files, it positions them to reduce the number of track-to-track operations needed to access them. Another fast and flexible defragmenter is Multisoft's *PC-Kwik Power Disk*, which also offers the most informative disk map available for DOS disks.

BACKUP UTILITIES

The backup programs in *PC Tools* (Microsoft Windows and DOS versions) and in *The Norton Desktop for Windows* rank among the fastest on the market. *The Norton Backup*, separately sold by Symantec Corp., remains invaluable as the DOS counterpart of the new Windows version. The next version of *Norton*'s DOS backup will include tape drive support (already in *PC Tools*), so there's little need to look elsewhere for a backup program.

Fifth Generation Systems' popular *Fastback Plus* (800-873-4384) has evolved into Version 3.02, producing speeds in the same range as *Norton* and *PC Tools* and a bafflingly obscure new menu system. The new version occasionally locked our test system after a backup session, and loyal users of Version 2.*x* may prefer to look around before upgrading.

DOS SHELLS

The file manager in *PC Tools* is overflowing with features, but its busy screen display won't appeal to everyone and it doesn't offer the lucid, smooth control that you can get with the XTree Co.'s *XTree Gold* (805-541-0604). *XTree Gold* excels at managing individual files, and nothing approaches its ability to give you quick access to files on multiple drives or to manage multiple files in multiple directories.

For users who want to stick with Symantec Corp.'s *Norton* product line for their file management, *The Norton Commander* is another good choice for DOS Shell functionality (800-441-7234 or 408-252-3570).

REMOTE CONTROL

Compared with Digital Communications Associates' *Remote2* (800-348-3221) and SoftKlone's *Takeover* (800-634-8670), *PC Tools*' Commute holds it own in features and performance, although *Takeover* has far more elaborate security options, which may ease your mind when your computer is in remote hands. ■

only part of your selected defaults, and you have to select drive letters from a menu instead of simply typing a list. The program that warehouses deleted files can easily fill your disk with deleted data unless you change its default settings. The help screen for DiskEdit's memory display says only "This dumps memory." The cache is bulkier and slightly slower than the competition. The Calibrate program always reports that the caching controller is defective after it tests two partitions in one session, but never when testing each partition in separate sessions.

If you judge packages by the number of functions included, you'll find that *The Norton Utilities* doesn't give you as many bytes for the buck as *PC Tools*, and to get *Norton*'s backup program you have to buy a separate package or get *The Norton Desktop for Windows*. But *Norton* is demonstrably better than its competition at essential tasks such as recovering lost files and manipulating every byte of your disks.

Despite minor quirks, *Norton* inspires confidence in its solidity and safety. If you value your disks and data, this is the one utility package your computer should never be without.

PC Tools

You can spend years exploring *PC Tools* and never reach the limit of its major features and minor problems. Central Point Software's $179 package, now in Version 7.1, lets you do more with your disks and files than any other utility software on the market.

It runs programs, finds files, recovers lost data, reconstructs defective database and spreadsheet files, salvages damaged disks, defends against viruses, encrypts

Suitability to Task

PC Tools

Data recovery			3	
Disk and file management				4
Applications management			3	
Desktop utilities				4

files, schedules alarms or applications, sends faxes and e-mail, backs up disks from DOS or Microsoft Windows, gives you the DOS equivalent of Windows *Desktop* programs, and a few dozen other things, too. If you're not satisfied with letting *PC Tools* manage your PC, its remote-control software lets you take over someone else's. When you get lost among the program's labyrinths or you can't figure out which of seven manuals to consult, know that even its own installation program sometimes loses track of where it installs files.

The heart of *PC Tools* is PC Shell, which functions as an application launcher but starts off looking like a file manager with side-by-side directory and file windows. Like the DOS 5.0 Shell, it lets you view directory trees in outline format, with expanding and collapsing branches. When you view files, they appear in their native formats (*The Norton Utilities* has only ASCII and hexadecimal viewers). From PC Shell you can access a memory map, find system information, hexadecimal-edit disk sectors (though not as effectively as with *Norton*'s DiskEdit), exchange files with a laptop, and call up hypertext help on the whole package. You can establish file associations that let you run a program by selecting a file from the file window. Because PC Shell feeds keystrokes to applications, it can load a spreadsheet without using *Lotus 1-2-3*'s File Retrieve command.

If you run PC Shell as a TSR, you can hotkey to it while running one program, run a second program, then return to the first. But although it looks like a twin of the DOS 5.0 Shell, it doesn't have the DOS Shell's full task switching, and you can't store multiple applications in memory as you can with the *WordPerfect Office* shell. Also, you can't use the hotkey within applications if you run command-line utilities. You can't load PC Shell into

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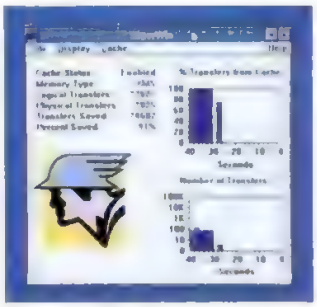

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high memory, but a swap program lets you stow it in EMS or XMS memory.

A menu takes you from PC Shell to other utilities in the package, including the Desktop programs and a full suite of disk utilities—notably a defragmenter, surface tester, and nondestructive low-level formatter. A setup program lets you install (among much else) a sleek, swift disk cache, a TSR that moves deleted files to a hidden directory, a screen blanker, and an almost ideal remote-control program called Commute, which uses data compression for high-speed communication and can detect *PC Tools*' graphics fonts on the remote machine and display them locally.

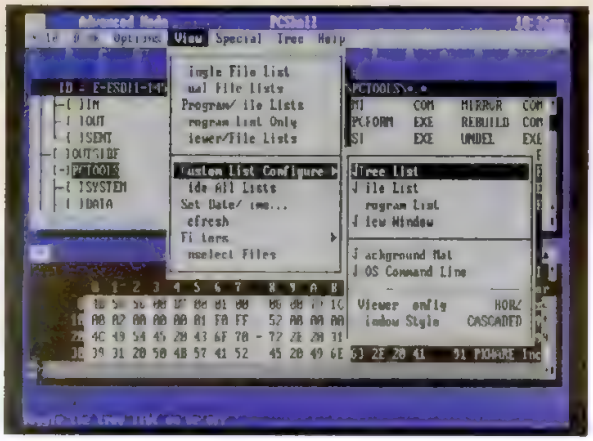
The TSR Desktop includes calculators, notepads, outliners, keyboard macros, a communications module with simple e-mail scripts and fax support for Intel or SpectraFax boards, a scheduler (complete with group calendars for network use), and lesser utilities such as an ASCII table that misleadingly displays the characters in *PC Tools*' graphics screen font instead of many real ASCII characters.

SIMILAR TO NORTON BUT DIFFERENT

Unlike *The Norton Utilities*, *PC Tools*' installation automatically creates a self-contained and bootable rescue disk that can restore your CMOS and partition table if disaster strikes. Unfortunately, to update this disk if your configuration changes calls for an unintuitive trip through the installation program. *PC Tools*' DiskFix offers the same functions as *Norton*'s NDD and Calibrate, and both packages have similar unerase and unformat programs. *PC Tools*' Mirror program for storing an image of the FAT and root directory is far slower than *Norton*'s similar Image program. In PC Magazine Labs' testing, however, *PC Tools* could not restore a small number of files that *Norton* recovered flawlessly. DiskFix, for example, quickly unscrambled circular cluster chains in the FAT, but in one instance reported no problems on a disk with a circular chain that CHKDSK recognized and NDD repaired.

PC Tools' UNDEL and *Norton*'s

Using *PC Tools*, Version 7.1, you will find that the menus in its Microsoft Windows backup program are lucid and uncluttered. The file-selection screen can be reduced to an icon while you make selections from other menus.



The menus for *PC Tools*' DOS utilities often seem slightly overloaded. Here, the file-management screen is divided into file and viewer menus, but each half can be made to fill the screen, and most menu bars and other features can be switched off for a calmer display.

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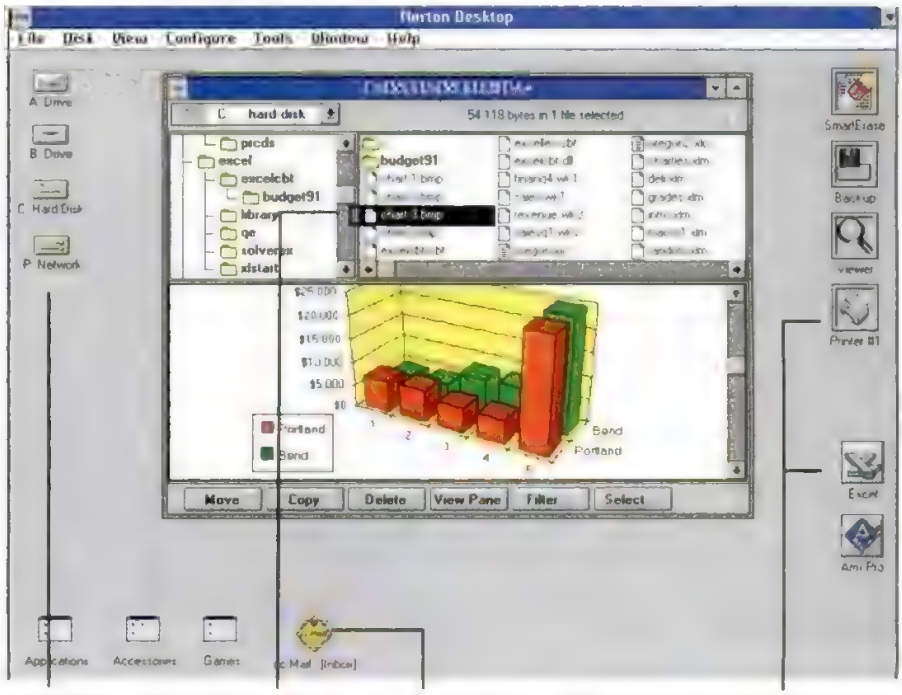

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***PC Tools*, Version 7.1**
Central Point Software, 15220 NW Greenbrier Pkwy., Beaverton, OR 97006; 800-445-4208, 503-690-8088.
List Price: $179.
Requires: 612K RAM, DOS 3.3 or later.
In Short: The amazing range of disk and desktop utilities in *PC Tools* continues to increase with the addition of a new remote-computing program and other enhancements. The rescue disk created during installation can be a lifesaver for your hard disk. The bugs in Version 7.0 are absent from Version 7.1, but the package still has some surprisingly rough edges.

CIRCLE 388 ON READER SERVICE CARD

Unerase are equally adept at recovering files when you've run the Mirror or Image programs (although UNDEL ignores *Norton*'s Image files). UNDEL, unlike *Norton*'s Unerase, isn't confused by SUBST drives. But when *PC Tools*' UNDEL scanned a disk for lost *dBASE* and *Lotus 1-2-3* files that could not be restored by more direct means, it first offered dozens of deleted file fragments for possible recovery, although only two contained database or spreadsheet data. Then, after we manually selected the right clusters by using the program's viewers until the missing files appeared in their native formats, UNDEL restored the full *dBASE* file but only half the spreadsheet. *Norton* located the right clusters and fully recovered both files with a few keystrokes.

WINDOWS-LIKE INTERFACE

Much of *PC Tools* has been overhauled to look like Windows, and the package comes with both DOS and Windows versions of its backup program. They use identical configuration files and create identical backup disks, and run at speeds virtually equal to *The Norton Backup*. Where *Norton*'s backup has obscure menus, the *PC Tools* programs are simple to customize and run, and are among the few backup programs with extensive support for tape drives. Curiously, as *PC Tools*' cache confuses *Norton*'s backup program, so *Norton*'s cache, on our test system, caused Unrecoverable Application Errors immediately after running the *PC Tools* Windows backup program.

A few other *PC Tools* programs run under Windows: an undelete program that doesn't allow the advanced manual recovery allowed by the DOS version in the same package, a simple launch menu that attaches itself to the Windows system menu, and a utility that receives messages from the package's TSRs. An oddly limited scheduler lets the DOS TSR scheduler work under Windows and lets you schedule DOS-based e-mail and remote-control sessions, but it can't schedule any Windows program except the *PC Tools* backup program.

ASTONISHING BARGAIN

When Version 7.0 of *PC Tools* first appeared, its numerous bugs prompted so many complaints that Central Point Software executives appeared on CompuServe to promise a quick fix. Version 7.1, sent free to registered users, banishes the major bugs but still has problems ranging from a disappearing mouse pointer in PC Shell to graphic fonts that sometimes display as nonsense characters when you run PC Shell under Windows.

No matter what drive you install to, the communications module will expect to find files on drive C:, and the program will shove its directory at the head of your DOS path. The installation creates Windows .PIF files for its DOS utilities but doesn't include full paths, so if you edit your DOS path, the .PIF files could call up a different program that had the same name instead of the *PC Tools* programs you expect.

Despite the flaws and anomalies, *PC Tools* remains the most astonishing bargain in DOS software. Version 7.1 restores much of the confidence eaten away by the bugs in 7.0, although it seems wise to keep other vendors' utilities on hand for emergencies. Beginners can use *PC Tools* as a powerful menu and backup system; experts can use its effective scheduling, remote-control, and file-management functions. No one needs all of *PC Tools*, but everyone can use some of it. ■

Edward Mendelson is a contributing editor of PC Magazine.

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You need to know the difference between computers that meet the FCC class B radio frequency emissions standards and those that meet only the Class A standards.

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Buyers seeking computers for use in homes (including offices at home) should shop for computers and peripherals which have been Class B certified. These devices carry a label with an FCC ID number. Both new and used Class A verified devices may be sold only for use in commercial and industrial locations. Signals from computers are more likely to be masked by electrical noise from other equipment in such an environment. These areas are also likely to have fewer radios and TVs. Accordingly, equipment marketed only for use in these locations may meet the less rigorous Class A standard. Class B certified equipment may be marketed for use in residences as well as commercial and industrial locations.

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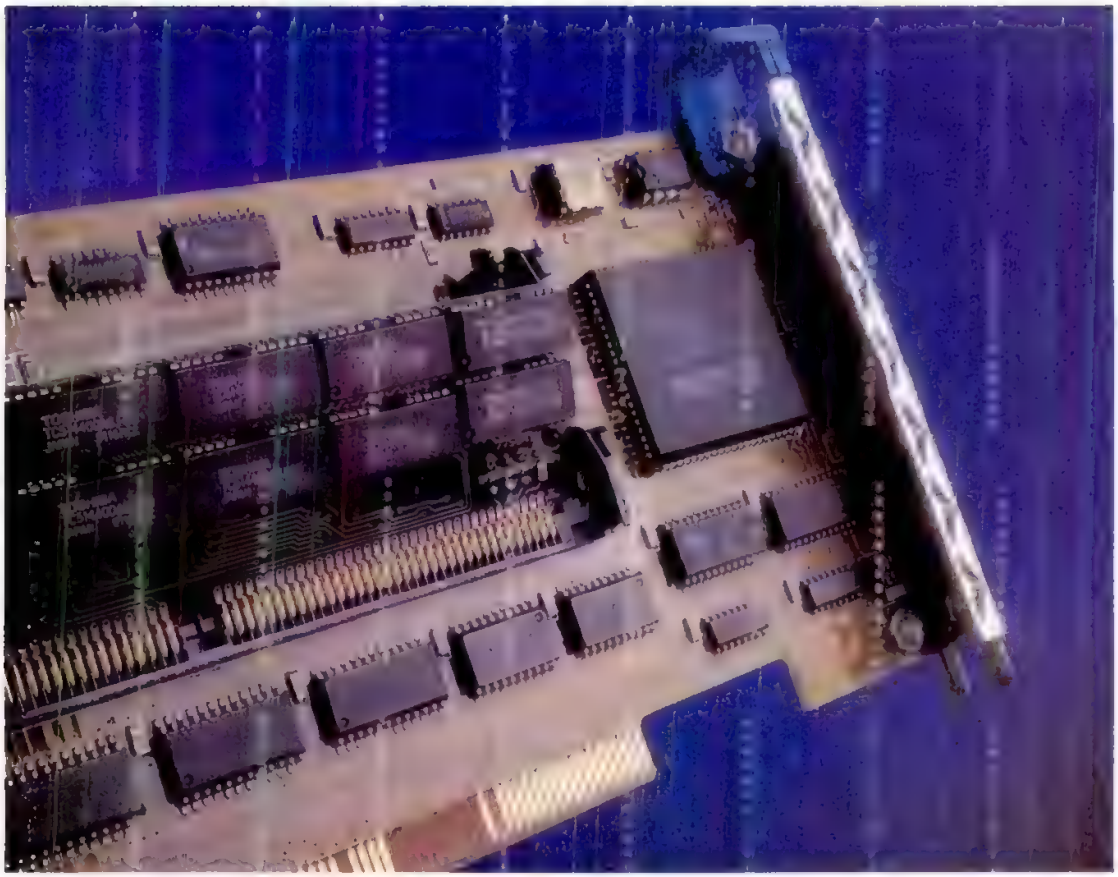

MCA Memory Boards

EXPANSION WITHOUT DELAY

Need more memory than the system board in your Micro Channel machine can hold? Moving to expansion board RAM is not the sacrifice it can be with ISA- and EISA-based systems. MCA expansion memory benefits from the architecture's faster bus and from features such as asynchronous operation. We review 11 MCA memory boards from 9 vendors.

PHOTOGRAPHY: BOB WOLFSON

by Winn L. Rosch

Slow poison—that's how expansion-bus memory on Industry Standard Architecture (ISA) and Extended Industry Standard Architecture (EISA) systems has been regarded traditionally. But memory on the Micro Channel is different. Rather than being sloughed off as second-rate, Micro Channel architecture (MCA) expansion-bus memory deserves serious consideration.

Unlike the 8-MHz bus in ISA and EISA systems, which poisons your machine with laggardly performance, the MCA bus offers a

faster base operating speed of 10 MHz. In IBM PS/2 Model 80s, where matched-memory-mode transfers are possible, the MCA bus can run as fast as 16 MHz. An added advantage of the MCA bus is that memory boards designed for it typically support data transfers at zero wait states on any PS/2 system. With ISA and EISA products, that is less likely to be the case.

Memory on the MCA bus actually can speed up some PS/2 systems. You will see a performance increase in 16-bit machines with one wait state, such as the IBM PS/2 Models 50 and 60. The boost comes from using zero-wait-state memory boards on the MCA bus in addition to the one-wait-state memory on the system boards of those machines. In other PS/2 machines, the penalty for going to the bus instead of the system board for memory is substantially less than with other expansion buses. According to PC Magazine Labs' tests using a 25-MHz IBM PS/2 Model 70-A21, with one of the top-performing MCA memory boards you can expect a loss of only 20 to 25 percent of system board memory throughput. In contrast, with memory boards for 33-MHz EISA machines, there might be as much as a 75 percent throughput loss.

DESIGN WITH A DIFFERENCE

The difference is by design. When MCA was originally conceived, it was supposed to handle expansion-bus memory with the same dispatch as system board RAM: 10 MHz on the original IBM PS/2 Models 50 and 60. Only when 386 microprocessors raced beyond 16 MHz did the speedy MCA bus not keep up. Even so, MCA expansion memory on a 16-MHz Model 80 still can run at least twice as fast as RAM on 8-MHz EISA or classic ISA buses (this is not true for the 16-MHz version of the Model 70).

On all PS/2 systems, the Micro Channel is designed to operate asynchronously; it need not be locked to the system clock. Theoretically, asynchronous operation could allow MCA expansion boards to operate at nearly unlimited speeds: say 40 MHz instead of 10 MHz. But in the real world no company fully takes advantage of the asynchronous functions of MCA, though some may take advantage of the capability to provide sporadic bursts of somewhat higher bus-speed operation.

For example, to achieve higher access rates, some boards allow matched memory transfers in Model 80s. Matched memory transfers speed up bus operations

ISA AND EISA EXPANSION-BUS MEMORY: Some Points to Consider

Undeniably, there are drawbacks to using expansion-bus memory on ISA or EISA machines. But there are also valid reasons for why you might find it useful—or necessary.

by Winn L. Rosch

If any one word describes bus memory for the classic AT (ISA) and EISA buses, it is *anathema*. With today's more powerful systems, nothing short of a 100-pound ball and chain could slow down your workday more. Bus memory operates so much slower than current machines' system board memory that your system can be bogged down to 25 percent or less of its potential speed.

In some cases, however, sliding a few megabytes of RAM into an expansion slot of an ISA or EISA machine makes sense. The primary instance is when your PC's bus speed closely matches its microprocessor speed. With such a system, you should face no penalty in using expansion-board memory because there will be no slowdown in accessing the bus. But this match works only in a few cases—generally 286 machines with CPU speeds between 6 and 12 MHz. With newer systems, as the CPU speed increases, the 8-MHz bus speed of ISA and EISA machines falls farther and farther behind.

All the wonders of EISA do not help the memory speed situation. Even EISA's fastest transfer rate—33 megabits per second (Mbps), used for Type C DMA operations—moves information at only one-quarter of the speed that a 33-MHz 80386 or 80486 microprocessor expects. These 32-bit microprocessors want information at 132 Mbps because they deal with data 4 bytes at a time. Since typical system board memory transfers do not use Type C, performance lags even more on EISA buses.

REASONS FOR ADDING RAM

The bottom line is that expansion-board memory will definitely handicap the performance of any ISA or EISA system with a microprocessor running faster than 12 MHz. Nevertheless, you may still have several viable reasons to put RAM on your ISA or EISA PC's expansion bus, such as a lack of other expansion capabilities. Some system boards have limited expansion capabilities, and slotted memory may be the only kind you can add. An all-too-common scenario arises when the system board uses a proprietary memory expansion board but you cannot acquire that board because the manufacturer is unreachable, is out of business, or never bothered to make the board in the first place.

You can also use expansion-board memory for a RAM disk. While the RAM drive will not be as fast as one created using system board memory, it will still easily outrace any mechanical disk drive.

As long as you configure the memory on the board to be addressed above the top of all system board memory (as it typically would be), it will be the last to be used by your applications. Only when a program needs every last byte will it reach into slowdown territory. Certainly performance will suffer at that point, but you will be able to run software you would not otherwise be able to use.

If you are using an environment that takes advantage of virtual memory techniques, such as Microsoft Windows 3.0, the slow slotted memory will still outperform the virtual memory that is emulated by a mechanical disk drive. While such slotted memory is not an ideal solution, it is affordable and practical. ■

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during reads and writes by accelerating the bus timing to 16 MHz from its normal 10 MHz.

REVIEW CRITERIA

The nine manufacturers represented here—Acculogic, Advanced Microcomputer Systems, Capital Equipment, Cumulus, Intel, Kingston Technology, Memrel, Orchid Technology, and Tecmar—offer a variety of memory boards to fill MCA expansion needs. To be included in this review, products had to be able to store at least 8MB of 32-bit memory and work in an IBM PS/2 Model 70-A21, which served as the test-bed. IBM is not represented because it was unable to deliver its product, the IBM Memory Expansion Option, in time for this review. We learned about RYBS Electronics' HICARD MC AMS too late to include it in this review.

Most of the boards delivered 80 percent of the PS/2 system board memory throughput in reading data, and about 71 percent in writing data.

PC Magazine Labs' Memory Read and Memory Write tests checked the performance of the boards by writing to every 4K block of memory on each board and checking transfer times for reading and writing. Because these boards all use clocked logic, you might expect that operations would occur at the same rate; any memory board you put in the system should operate in lockstep with the bus clock. But design differences gave some boards performance advantages. For example, most boards operated at zero wait states, while a few imposed memory wait states. Most of the boards were able to deliver 80 percent of the PS/2 system board memory throughput in reading data, and about 71 percent in writing data.

One board that imposes one memory wait state, Advanced Microcomputer Systems' AMS Memory 32 DI, performed at 66 percent of the system board speed in reading data. Cumulus's CuRAM-MC32 performs memory reads at zero wait states but memory writes at one wait state (according to the company); it performed at 50 percent of system board speed in writing data. This was only slightly better than the AMS Memory 32 DI's writing speed. Interestingly, Orchid Technology claims that its RamQuest 16/32 operates at zero wait states for all operations, but the RamQuest actually performed poorly on our Memory Write test.

In many cases, the board's ability to use the Model 70's RAM cache helped its performance. While the memory on most of these boards can take advantage of the Model 70's RAM cache, boards that initialize memory after the host system's self-test generally cannot.

ADVANCED SUPPORT

Only a few boards claim support for any of the advanced features of the Micro Channel-2 specification published with the release of the original RS/6000 chip: boards that could speed transfers by a factor of 4 to 8 as well as ensure the integrity of such transfers. Kingston Technology claims that its boards are compatible with all advanced modes; Advanced Microcomputer Systems claims that its AMS Memory 32 DI allows multiplexed data transfers. These functions could not be tested because no PS/2s currently use these modes. (Cumulus has announced plans to deliver the first PC-class machine to use these modes in the first quarter of 1992.) None of the boards evaluated here are recommended by their manufacturers for MCA computers outside the PS/2 line that use these advanced modes today, such as the RS/6000 and AS/400.

Beyond speed and advanced modes, a number of other differences distinguish these products. Prices for these boards range from $275 (for the AMS Memory 32 DI with only 1MB of RAM) to $2,429 (for the Capital OS/RAM 32 Plus stuffed with 32MB of memory). Some manufacturers, such as Acculogic and Tecmar, prefer to sell you their boards with no memory at all. Other differences of principal concern include the following:

■ **Capacity.** You'll want as much capacity as possible for future expansion. The Capital OS/RAM 32 Plus lets you add 128MB of RAM to your system, although 32MB is actually a more common figure

EDITORS' CHOICE

■ **MicroRAM SC**

Speed is not an issue among the better MCA memory boards. Most of the products in this review combine fast SIMM chips with zero wait states to achieve the same level of top-flight performance.

The important qualities to consider for MCA memory boards include a product's flexibility and smooth integration into the Micro Channel architecture. Tecmar's MicroRAM SC exemplifies both those qualities. In an arena where the products differ from each other only slightly, this board is the standout performer.

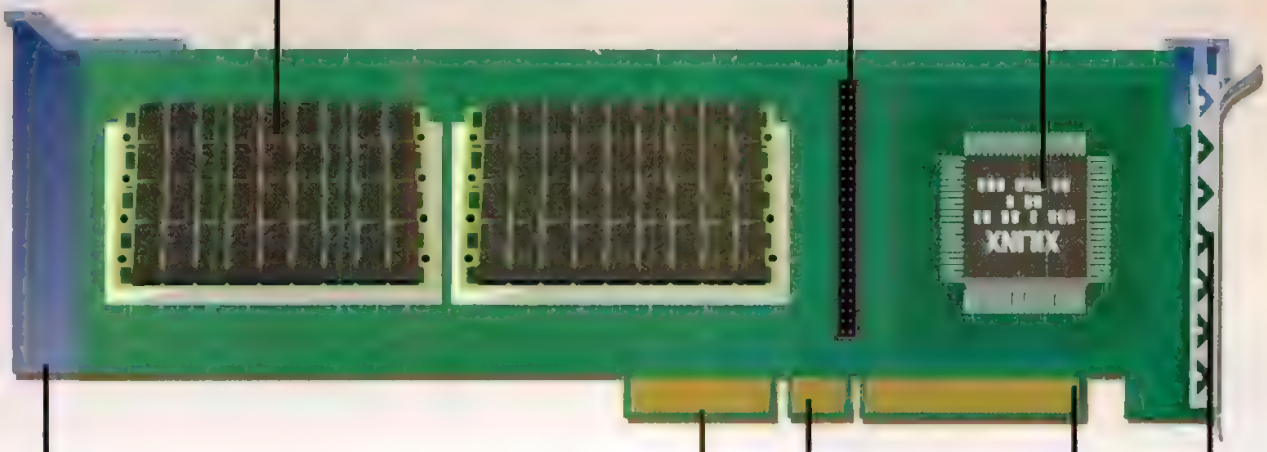
In addition to the top-tier ratings the MicroRAM SC achieved on our PC Labs performance tests, the board uses any size of 36-bit SIMMs in any combination of 1MB, 2MB, 4MB, and 8MB capacities, allowing corporate inventory to be streamlined. The MicroRAM SC also makes installing additional memory in your 16- or 32-bit PS/2 as pain-free as possible. For example, you do not have to fill sockets in numerical order, with larger-capacity SIMMs going into lower-numbered sockets, as you must do with some other boards reviewed here.

The MicroRAM SC seamlessly melds with your PC: no need to worry about operating system–specific drivers or added complications in the configuration process. The package is neatly put together, using primarily surface-mount circuitry, while many other boards are still using pin-in-hole technology.

With 8MB of RAM installed, the MicroRAM SC is not the least expensive product reviewed here, but you can opt to buy the board bare for $360 and fill it up on less expensive memory chips from other sources. In whatever configuration you buy the MicroRAM SC, you will be glad you made the investment.

ANATOMY OF A MICRO CHANNEL MEMORY BOARD

The memory boards in this review are easily recognizable by their 32-bit connectors, four or eight SIMM sockets (generally 9- or 36-bit), and large ASIC memory controller. Some memory boards also possess an optional I/O daughterboard, which can contain parallel and serial ports.



Socketed SIMMs in four or eight places provide memory for expansion. Two SIMM types are generally used: 9-bit SIMMs, which must be added in banks of two for 16-bit machines and banks of four for 32-bit computers, and 36-bit SIMMs, each of which makes an entire bank for either 16- or 32-bit machines.

Some memory boards include a header that allows you to add optional I/O ports mounted on a daughterboard.

An ASIC (application-specific integrated circuit) is generally used to match memory to the Micro Channel.

The extended card guide ensures that the board stays straight in its socket. In addition, the card guide provides a grip so that you can remove or insert a board without touching the circuitry. It is also part of the air baffle that helps create a cooling airflow over all the components.

Most memory boards split the 32-bit MCA extension so that one board will fit into both 16- and 32-bit PS/2s. Signals on the bus allow the board to determine which type of computer it is plugged into.

The basic 8-bit MCA connector

A specially designed retaining bracket for positive grounding reduces interference and guarantees system integrity. It also aids in maintaining a cooling airflow over the system.

with most of the products. While today's MCA computers do not allow DMA (direct memory access) transfers beyond 16MB, the added memory can be used by other operating systems, such as *NetWare*, or other functions not needing DMA, such as EMS (expanded memory specification) memory or disk caches.

■ **Integration.** To be useful, the memory on MCA boards must be integrated with the rest of the memory in the system. Two principal methods are used for doing so. The Track Zero method loads a special driver from the first track on the host's hard disk before the operating system loads. BIOS-compatible boards, on the other hand, integrate memory before or during the self-test.

Because Track Zero memory is not found during IBM's self-test, it may not be understood by the rest of the system and might not be cached.

BIOS-compatible boards are better for several reasons. Track Zero is incompatible with some operating systems that reserve that track for other functions, such as *NetWare*. The Track Zero technique relies on the quality of the memory board manufacturer's diagnostics to find and reserve bad bytes, a function normally handled by IBM's self-test. Because Track Zero memory is not found during IBM's self-test, it may not be understood by the rest of the system hardware and, more importantly, might not be cached. In

addition, memory integrated with Track Zero drivers may be invisible to some programs. And such memory just disappears when you boot from a floppy disk because the necessary Track Zero driver does not load.

■ **SIMM type.** Several types of SIMMs are used on various memory products. The two most common are 9-bit and 36-bit (the latter are generally referred to as IBM motherboard–style SIMMs). The 9-bit chips must be added in banks—banks of two for 16-bit operation, banks of four for 32-bit. This limits the number of different memory configurations available on a board. While most boards allow you to mix different capacities of 9-bit SIMMs in the appropriate bank size, Intel's Above-Board MC allows only a single 9-bit SIMM size on a board. On the other hand, IBM-style 36-bit modules can be expanded in increments of one module, and any variety of SIMM capacities can be used on a single board.

■ **Backfill.** Some of these MCA memory boards can backfill system board memory—that is, use memory from the expansion board to flesh out the base system board memory to the full 640K. While this seems a dubious virtue when all PS/2s have at least 1MB on their system boards from the factory, it has important implications for the 286-based PS/2 Models 50 and 60. Backfilled memory operating at zero wait states can replace those models' one-wait-state system board memory, potentially improving throughput by 50 percent. In these systems, a simple memory board acts like a turbocharger.

Backfilled memory operating at zero wait states can replace one-wait-state system board memory, improving throughput by 50 percent.

Certainly the best way to begin adding memory to most PS/2s is on the system board, where it will always operate at full microprocessor speed no matter what the class of machine. But if you need more, you can plug in one of these MCA memory boards without worrying that it will have a lethal effect on your PC.

ACCULOGIC INC.
SIMMply-RAM for the PS/2-32

The name—SIMMply-RAM for the PS/2-32—certainly describes Acculogic's marketing intent: nothing but memory in the form of SIMMs. The board's $459 list price (you can find it for about $360 on the street) includes no memory; you or your dealer stuff the card with SIMMs. According to Acculogic, an 8MB version would cost about $1,099.

The specifications of Acculogic's SIMMply-RAM are versatile enough to

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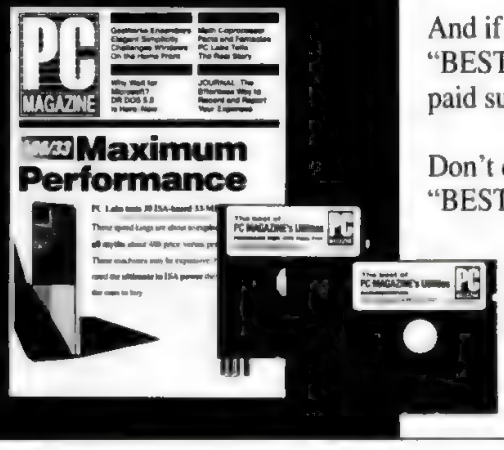

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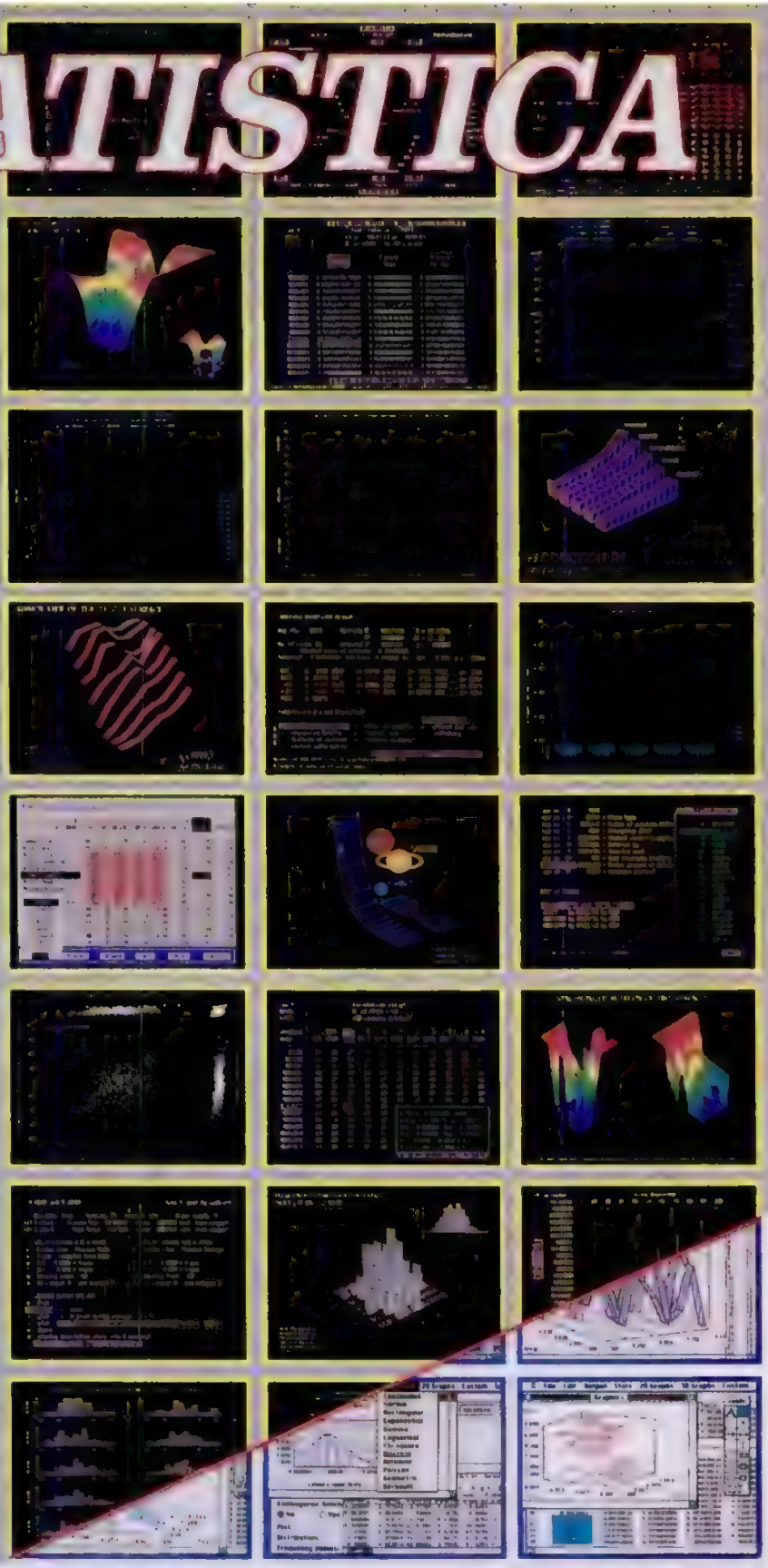

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MCA MEMORY BOARDS: SUMMARY OF FEATURES

Products listed in alphabetical order

	AboveBoard MC	AMS Memory 32 DI	Capital OS/RAM 32	Capital OS/RAM 32 Plus	CuRAM-MC32	Kingston KTM 3011-4
List price (tested configuration)	$999	$625	$786	$798	$1,574	$2,425
MEMORY						
Installed RAM (tested configuration)	4MB	8MB	8MB	8MB	8MB	8MB
Maximum RAM capacity	32MB	16MB	8MB	128MB	32MB	16MB
SIMM type	9-bit	36-bit	9-bit	9-bit	36-bit	36-bit
Maximum number of SIMMs installable	8	4	8	8	4	4
SIMM sizes supported:						
256K	■	❑	■	❑	❑	❑
1MB	■	■	■	■	■	■
2MB	❑	■	❑	❑	■	■
4MB	■	■	❑	■	■	■
8MB	❑	❑	❑	❑	■	❑
16MB	❑	❑	❑	■	❑	❑
Method of integration	BIOS	BIOS	BIOS	BIOS	BIOS, Track Zero	BIOS
Memory recognized during POST	❑	■	❑	❑	■	■
Can backfill system board memory	■	❑	❑	■	❑	❑
Ports	1 parallel, 1 serial ($149)	1 parallel, 1 serial ($50)	None	None	None	None
COMPATIBILITY						
PS/2 Models 50 through 65SX	■	❑	■	■	❑	❑
PS/2 Models 70 through 80	■	■	■	■	■	■
PS/2 Models 90 through 95	❑	■	■	■	■	■

PC —Editors' Choice ■ —Yes ❑ —No

make it a viable contender for any PS/2 Model 70, 80, 90, or 95, the models for which Acculogic recommends the board. The four sockets for IBM-style 36-bit SIMMs will accommodate any standard-size module; you can snap in 1MB, 2MB, 4MB, or 8MB in any place or order. The board can yield from 1MB to 32MB in a single slot.

HARDWARE DIFFICULTIES

Acculogic supplied a variety of SIMMs on the evaluation board to demonstrate this versatility. All of the supplied SIMMs were rated at 80 nanoseconds. The first SIMMply-RAM board we received and installed generated a system error, which could not be explained by the manufacturer but could have been attributed to shipping damage.

The replacement board proved to be a real disappointment when it came to installation. It did not fit correctly in a 32-bit MCA expansion slot; this problem should not occur if a board is properly designed with the dimensional reference at the center of the slot connector. With some effort, the board was successfully installed in its slot, but it balked when we tried to use the SIMMs from the old SIMMply-RAM board. Adding two 80-ns. 4MB SIMMs supplied by Kingston Technology finally brought the SIMMply-RAM to life, however.

Outside the dimensional problem, the working evaluation board was well laid out and entirely populated with surface-mount components (except for the BIOS chip). After installation, it proved to be a perfect match with the test-bed Model 70; the board was fully recognized by the system's POST (power-on self-test). The SIMMply-RAM fully conforms with IBM's software configuration procedure: After installing the board, you run the IBM Reference Disk and it executes the setup. The board's performance on our tests put it at the top of its class with most of its competitors.

Acculogic supplies a memory manager it codeveloped, called *QMAPS*, that converts extended memory to EMS or XMS (extended memory specification), allows drivers and TSRs to be loaded into high DOS memory, and includes a RAM disk, disk cache, and print spooler. The MCA board itself, however, is covered by only a rather skimpy two-year warranty.

It is unfortunate that the Acculogic SIMMply-RAM simply does not fit better in a PC slot, but the memory board clearly has certain advantages—among them good and competitive performance—that make it worth considering.

FACT FILE

SIMMply-RAM for the PS/2-32
Acculogic Inc., 13715 Alton Pkwy., Irvine, CA 92718; 800-234-7811, 714-454-2441.
List Price: Without memory, $459.
Works With: IBM PS/2 Models 70 through 95.
In Short: Acculogic's SIMMply-RAM for the PS/2-32 is long on performance and long in the slot—too long for a good fit. Although tough to slide into a PS/2, the board will add up to 32MB to any 32-bit system.

CIRCLE 412 ON READER SERVICE CARD

MicroRAM SC	MicroRAM 386	Parity+Plus P32010	RamQuest 16/32	SIMMply-RAM for the PS/2-32
$1,160	$1,190	$795	$1,229	$459
8MB	8MB	8MB	8MB	None
32MB	32MB	8MB	8MB	32MB
36-bit	9-bit	9-bit	9-bit	36-bit
4	8	8	8	4
❑	■	■	■	❑
■	■	■	■	■
■	❑	❑	❑	■
■	■	❑	❑	■
■	❑	❑	❑	■
❑	❑	❑	❑	❑
BIOS	BIOS	Track Zero	BIOS	BIOS
■	■	❑	■	■
■	■	❑	■	❑
None	1 parallel, 2 serial ($120)	None	1 parallel, 1 serial (included)	None
■	❑	❑	■	❑
■	■	■	■	■
■	■	❑	❑	■

ADVANCED MICROCOMPUTER SYSTEMS INC.

AMS Memory 32 DI

The AMS Memory 32 DI from Advanced Microcomputer Systems (AMS) harks back to olden days, with a price that recalls the era before inflation. Unfortunately, performance leaves something to be desired, partly because the Memory 32 DI suffers from added wait states.

As a bare board, the $225 Memory 32 DI is the least expensive product in this review; its maker estimates a street price as low as $180. Add $50 per megabyte for as much RAM as you need, up to 16MB; an 8MB board lists for only $625.

The Memory 32 DI is designed for 32-bit systems only; AMS claims its product is compatible with all PS/2s from the Model 70 to 95. At the heart of the Memory 32 DI board are four SIMM sockets, each of which accommodates a 72-pin, 36-bit IBM-style SIMM of either 1MB, 2MB, or 4MB capacity. Different module sizes can be mixed on a single board with two provisos: Sockets must be filled in numerical order from bank one to bank four, and larger-capacity SIMMs must go in the lower-numbered banks.

The Memory 32 DI requires 80-nanosecond or better SIMM chips (which are necessary for Model 80 matched memory timing); for testing, the company delivered its 80-ns. SIMMs in the form of two 4MB modules. Notwithstanding the quick SIMMs, the board plodded along as one of the slowest in the roundup.

FACT FILE

AMS Memory 32 DI
Advanced Microcomputer Systems Inc., 1321 NW 65th Pl., Fort Lauderdale, FL 33309; 800-972-3733, 305-975-9515.
List Price: Without memory, $225; with 8MB RAM, $625. One parallel and one serial port, $50.
Works With: IBM PS/2 Models 70 through 95.
In Short: The AMS Memory 32 DI is the cheapest but one of the slowest of the MCA boards we tested. It is built with older technology and can add 16MB only to 32-bit systems.

CIRCLE 413 ON READER SERVICE CARD

ADDED I/O CAPABILITY

If you need extra I/O in your PS/2, the Memory 32 DI gives you the option of adding one serial and one parallel port using a $50 L-shaped daughterboard. Connections are brought out as a single female 37-pin D-shell connector. AMS supplies an 8-inch two-headed adapter cable to provide a conventional 25-pin male D-shell for the serial port and a female 25-pin D-shell for the parallel port.

The board's construction is vintage pin-in-hole, made mostly from discrete components. Workmanship is nevertheless very good, though protected by only a two-year warranty. The board follows the standard IBM software configuration procedure and flawlessly mates with the host system using BIOS code.

Though the price is right, the performance of the AMS Memory 32 DI clearly is not. Select elsewhere if speedy throughput is your prime concern.

CAPITAL EQUIPMENT CORP.

Capital OS/RAM 32
Capital OS/RAM 32 Plus

Simple SIMMs and flexibility are the hallmarks of the Capital OS/RAM 32 and Capital OS/RAM 32 Plus, from Capital Equipment Corp. Both boards use standard 9-bit SIMMs for inexpensive memory expansion, yet deliver top speed. The OS/RAM 32 Plus adds extra versatility for mixing and matching various SIMM types, so you can upgrade modestly or extravagantly.

Capital Equipment's pricing helps keep your memory investment on the modest side. With 8MB, the boards bear closely matching list prices: $786 for the OS/RAM 32 and $798 for the OS/RAM 32 Plus. The basic OS/RAM 32 with no memory costs $299, while a similarly configured OS/RAM 32 Plus is $349.

ADAPTABLE SIBLINGS

The twins share the ability to adapt to either 16-bit or 32-bit computers. When two or six SIMMs are installed in the eight available SIMM sockets, the boards are forced into 16-bit operation, compatible

IBM PS/2s: A SURVEY OF MEMORY CAPACITIES

The table below illustrates the memory capabilities of the systems that comprise IBM's PS/2 Micro Channel line. We have included information on currently shipping machines as well as on discontinued models. Note that when originally introduced, the Models 90 XP 486-0J5, -0J9, and -0KD, and the 95 XP 486-0J9, -0JD, and -0KD came with only 4MB of RAM and were rated at a maximum system board capacity of 32MB. The shift to the values shown in the table was made in September of 1991.

	Installed RAM (megabytes)	Maximum system board RAM (megabytes)	Total system RAM (megabytes)
16-BIT SYSTEMS			
50-031	1	2	16
50-061	1	2	16
50-Z31	2	8	16
50Z-061	2	8	16
55LS-LE0	4	8	16
55LS-LT0	4	8	16
55SX-031	4	8	16
55SX-041	4	8	16
55SX-061	4	8	16
55SX-081	4	8	16
57SX-045	4	16	16
57SX-049	4	16	16
60-041	1	1	16
60-071	1	1	16
65SX-061	2	8	16
65SX-121	2	8	16
65SX-321	2	8	16
32-BIT SYSTEMS			
70-061	2	6	16
70-081	4	6	16
70-121	2	6	16
70-161	4	6	16
70-A16	4	8	16
70-A21	2	8	16
70-A61	2	8	16

CONTINUES

with all PS/2s except those with memory caches (such as the test-bed 25-MHz IBM PS/2 Model 70-A21). With four or eight SIMMs, the boards will operate in either 16- or 32-bit mode in any PS/2, Model 50 through 95.

The basic OS/RAM 32 accommodates only 256K or 1MB SIMMs, allowing a minimum of 1MB of expansion and a maximum of 8MB on a single board. The OS/RAM 32 Plus accepts 1MB, 4MB, or 16MB SIMMs for a minimum 32-bit capacity of 4MB and a maximum of 128MB. Different sizes are allowed on the board but not within the same banks. To ease the management tasks of such an extreme amount of memory, Capital Equipment includes a RAM disk driver that allows the creation of four 32MB RAM disks.

Besides offering chip versatility, the OS/RAM 32 Plus adds 8,192 page-mapping registers to the basic features. These registers allow the board to emulate EEMS and backfill system board memory (but only as a single 640K block). Memory operations in slower 16-bit PS/2s could benefit from the board's zero-wait-state performance.

Both products abstain from IBM's Track Zero integration scheme. The boards support *NetWare* as well as DOS, OS/2, and Unix. Capital Equipment includes its own automatic installation program to manage the setup, which you must run before performing IBM's normal system configuration. (With products that follow the IBM spec to the letter, software installation should occur automatically as part of the IBM configuration sequence.) This results in board initialization not being completely integrated into IBM's POST. Still, the boards' performance indicates top-flight zero-wait-state activity and the use of system RAM cache.

Included with the setup program are EMS and XMS driver software, diagnostics, and utilities (the RAM disk and a memory and I/O mapping program). The boards are protected by a two-year warranty in an arena where many of the products offer five-year warranties.

While the boards are affordable and fast, integration of their equipment memory was not seamless; one of our test programs failed to recognize all the memory on the boards. Similarly, some application software might encounter problems recognizing this memory. But the speed and price of the Capital OS/RAM 32 and the Capital OS/RAM 32 Plus still make the pair compelling choices.

FACT FILE

Capital Equipment Corp., 76 Blanchard Rd., Burlington, MA 01803; 800-234-4232, 617-273-1818.

Capital OS/RAM 32
List Price: Without memory, $299; with 2MB RAM, $389; with 4MB, $559; with 6MB, $689; with 8MB, $786.
Works With: IBM PS/2 Models 50 through 95.
In Short: The fast and affordable Capital OS/RAM 32 will add up to 8MB RAM to any PS/2 from Models 50 through 95. But like the Capital OS/RAM 32 Plus, it lacks complete IBM integration into the MCA design.

Capital OS/RAM 32 Plus
List Price: Without memory, $349; with 4MB RAM, $598; with 8MB, $798; with 10MB, $998; with 12MB, $1,129; with 16MB, $1,389; with 18MB, $1,519; with 20MB, $1,649; with 24MB, $1,969; with 32MB, $2,429.
Works With: IBM PS/2 Models 50 through 95.
In Short: A board for those with megabyte madness, the Capital OS/RAM 32 Plus adds up to 128MB RAM to any IBM PS/2 from Model 50 through 95. The OS/RAM 32 Plus lacks only complete IBM integration into the MCA design. Its performance is first-class and its price is right.

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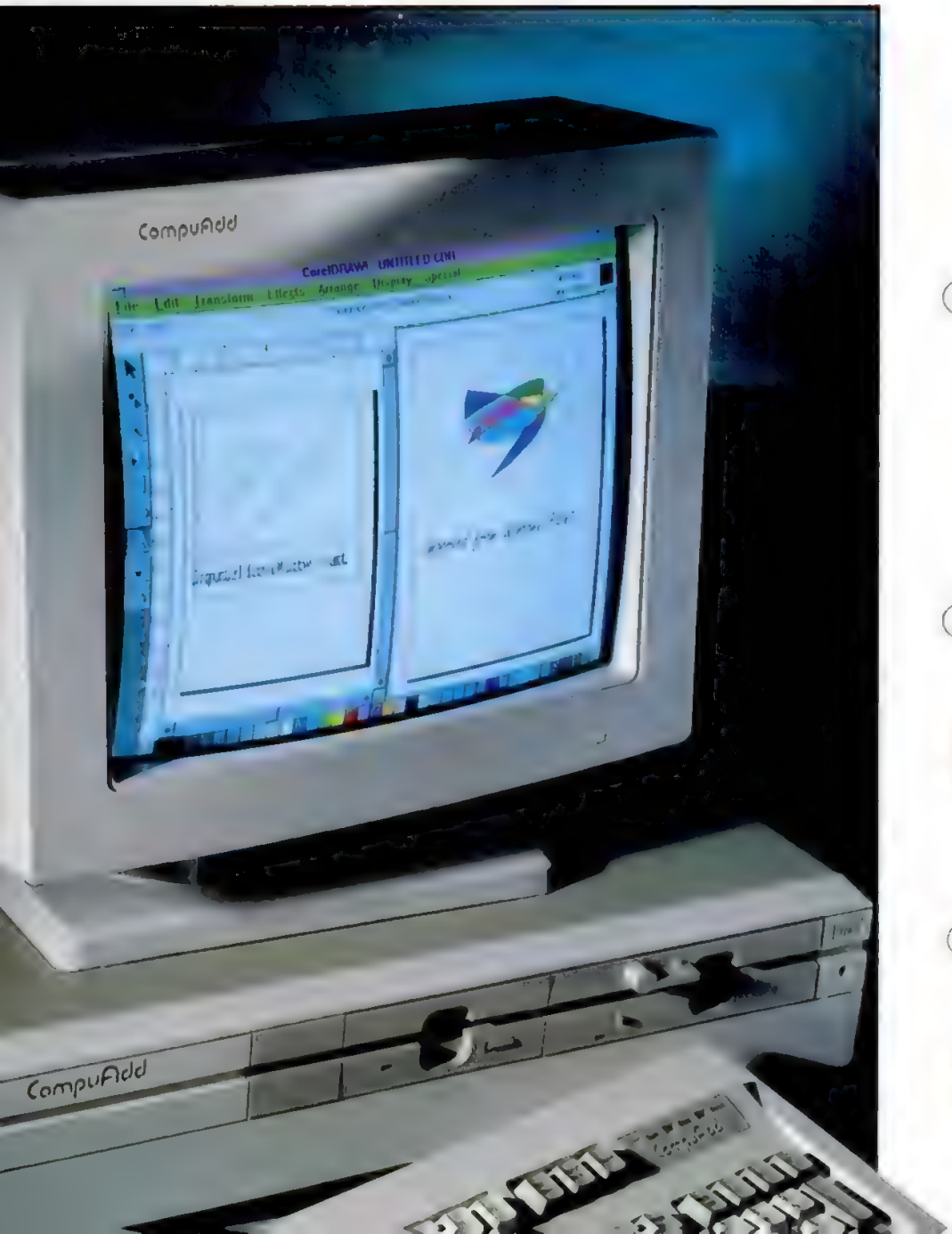

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	40MB	80MB
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High-Resolution VGA	$1395	$1595

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Monitor and Hard Drive Options

	40MB	80MB
320sc		
MGA	$1495	$1695
High-Resolution VGA	$1795	$1995

CompuAdd's newest stretch chassis, low profile system features the hottest innovation on the market: *local video*. Avoid the system bottlenecks of the AT-bus and achieve wait states to-video memory equivalent to DRAM memory! ***Now With 32K Cache!***

Monitor and Hard Drive Options

	40MB	80MB
325		
MGA	$1795	$1995
High-Resolution VGA	$2195	$2395

We've built the video on the local bus and stretched the chassis to two accessible 5.25" and two 3.5" internal bays, so you get the greatest expandability and flexibility available in a low profile system. The CompuAdd 333 also offers 128KB built-in cache memory — twice the industry norm!

Monitor and Hard Drive Options

	80MB	120MB
333		
MGA	$2195	$2295
High-Resolution VGA	$2595	$2695

Our new stretch chassis gives you expandability in a low profile, small footprint design! It's roomy enough for two internal 3.5" hard drives plus two accessible 5.25" drive bays — allowing you an extra 5.25" floppy drive, CD ROM or a tape backup.

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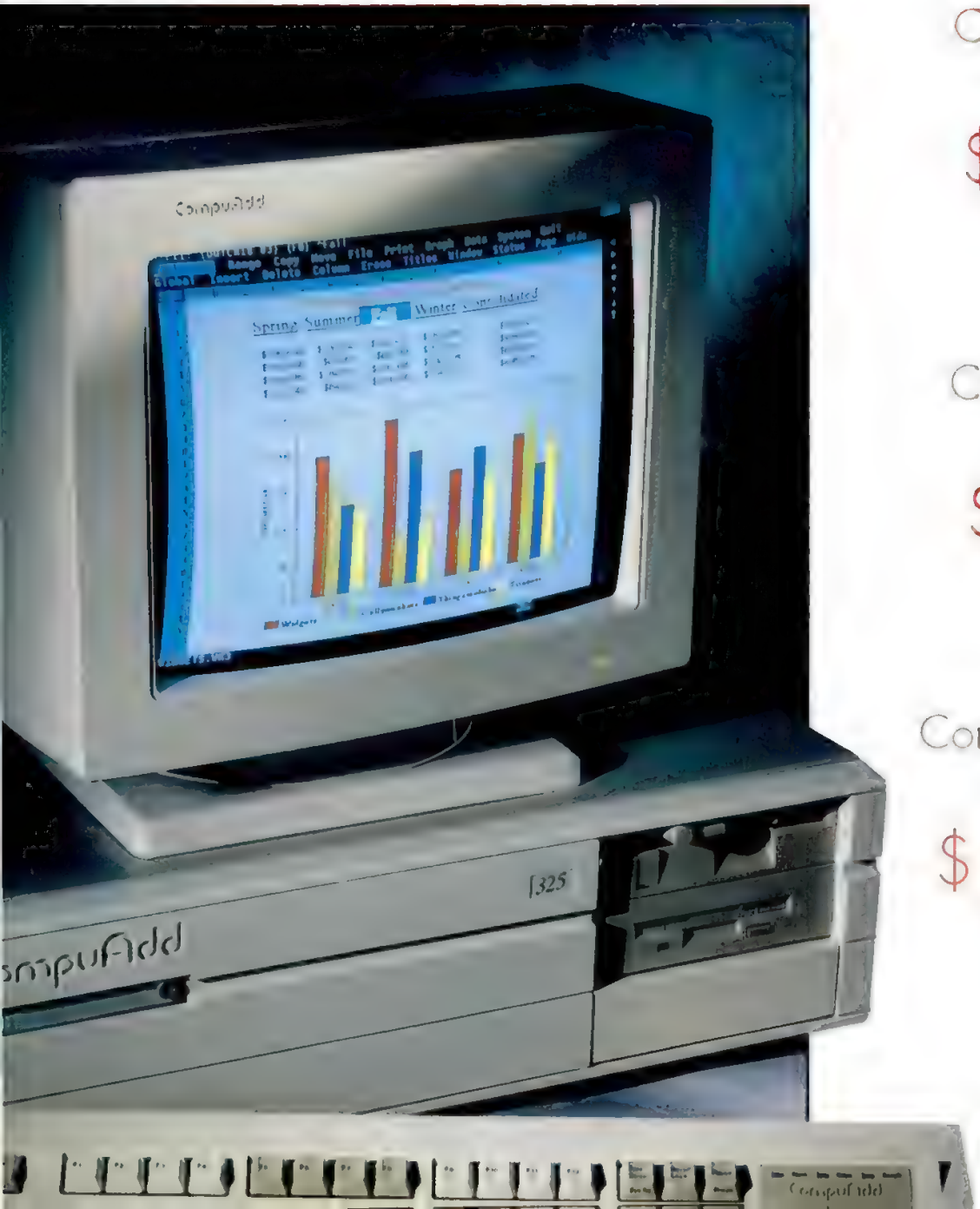

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Monitor and Hard Drive Options

	40MB	80MB
325		
MGA	$1895	$2095
High-Resolution VGA	$2265	$2465

PC Magazine chose the 333 as a finalist in its Technical Excellence Awards. Two 16-bit expansion "hot slots" are provided for the HardCache/ESDI controller and Hi-Rez VGA graphics card. Plug them in for spectacular data transfer and video performance! The optional 640KB SRAM card puts DOS and DOS-based applications into true 0 wait-state memory.

Monitor and Hard Drive Options

	80MB	120MB
333		
MGA	$2595	$2695
High-Resolution VGA	$2985	$3085

The expanded 32-bit EISA bus lets you access any memory or peripheral device installed on the system — regardless of bus width! Use your old 16-bit peripheral cards alongside new 32-bit EISA cards with no compatibility problems. A "hot slot" for the Hi-REZ VGA controller and a specially designed optional cache module move your data through at lightning speed.

Monitor and Hard Drive Options

	80MB	120MB
433E		
MGA	$3195	$3295
High-Resolution VGA	$3585	$3685

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IBM PS/2s: MEMORY CAPACITIES

	Installed RAM (megabytes)	Maximum system board RAM (megabytes)	Total system RAM (megabytes)
32-BIT SYSTEMS (continued)			
70-A81	4	8	16
70-E61	2	6	16
70 486-B21	2	8	16
70 486-B61	2	8	16
80-041	1	2	16
80-071	2	2	16
80-081	4	4	16
80-111	2	4	16
80-121	2	4	16
80-161	4	4	16
80-311	2	4	16
80-321	2	4	16
80-A16	4	8	16
80-A21	4	8	16
80-A31	4	8	16
90 XP 486-0J5	8	64	64
90 XP 486-0J9	8	64	64
90 XP 486-0KD	8	64	64
90 XP 486SX-0G5	4	64	64
90 XP 486SX-0G9	4	64	64
90 XP 486SX-0H5	8	64	64
90 XP 486SX-0H9	8	64	64
90 XP 486SX-0K9	8	64	64
90 XP 486SX-0KF	8	64	64
95 XP 486-0G9	4	64	64
95 XP 486-0GF	4	64	64
95 XP 486-0J9	8	64	64
95 XP 486-0JD	8	64	64
95 XP 486-0JF	8	64	64
95 XP 486-0KD	8	64	64
95 XP 486-0KF	8	64	64
95 XP 486SX-0H9	8	64	64
95 XP 486SX-0HF	8	64	64
32-BIT PORTABLE SYSTEMS			
P70 386-031	2	8	16
P70 386-061	4	8	16
P70 386-121	4	8	16
P75 486-161	8	16	16
P75 486-401	8	16	16

ENDS

FACT FILE

CuRAM-MC32
Cumulus Corp., 23500 Mercantile Rd., Beechwood, OH 44122; 216-464-2211.
List Price: With 2MB RAM, $899; with 8MB, $1,574.
Works With: IBM PS/2 Models 70 through 95.
In Short: The CuRAM-MC32 is a chameleon board that faithfully emulates the IBM original or goes its own way to add up to 32MB to 32-bit PS/2s. Its main weakness is slow performance in memory writing.

CIRCLE 415 ON READER SERVICE CARD

CUMULUS CORP.

CuRAM-MC32

Think of the CuRAM-MC32, from Cumulus Corp., as a chameleon. To match your state of mind, the 32-bit-only board allows a choice of operating modes: an IBM emulation that is compatible with IBM's Memory Expansion Option board and a higher-capacity native mode. The CuRAM is compatible with IBM PS/2 Models 70 through 95.

The basic CuRAM that Cumulus sells is stocked with 2MB and retails for $899. The company sells 1MB ($100), 2MB ($225), 4MB ($450), and 8MB ($900) SIMMs to increase the capacity of the CuRAM. The board we tested, with 8MB, sells for $1,574.

TWO OPERATING MODES

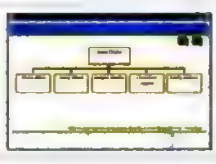
The chief difference between the CuRAM's two operating modes is SIMM support. In the high-capacity native mode, the CuRAM holds up to 32MB. In conventional or IBM mode, the CuRAM's capacity is limited to 16MB (the IBM board accepts less than that, however). You will choose the latter only if you want the peace of mind of knowing your memory expansion follows the IBM configuration standard right down to running IBM's diagnostics.

To accommodate the 36-bit IBM-style SIMMs, the CuRAM holds four sockets. Each of these can be stocked with 1MB, 2MB, 4MB, or 8MB SIMM chips, allowing a minimal board capacity of 1MB and a maximum of 32MB (in native mode). In IBM-emulation mode, 8MB SIMMs are prohibited. Otherwise, different-size SIMMs can be mixed indiscriminantly on the board, any size in any socket. The evaluation sample was stuffed with four 2MB SIMMs, each rated at 80 nanoseconds.

These SIMMs were enough to put the CuRAM's read performance at the top of the list. Cumulus claims that the CuRAM writes to memory at one wait state; its write performance did clearly show a drop-off from its zero-wait-state read performance. But the board still performed a little better on our Memory Write test than the other one-wait-state products.

The design and construction of the CuRAM are very good. The board uses surface-mount technology; the sockets are angled downward and project out to make the board no more than 0.6 inches thick. The only out-of-place element on the board is the one jumper used to select between native and IBM-emulation modes. The CuRAM integrates well with the standard PS/2 procedure in either of its operating modes. It is able to run any standard operating system from DOS to AIX, *NetWare*, OS/2, and Unix. The board is protected by a five-year warranty.

From all standpoints except write performance, the CuRAM-MC32 ranks as a choice worth considering for enhancing any 32-bit PS/2.



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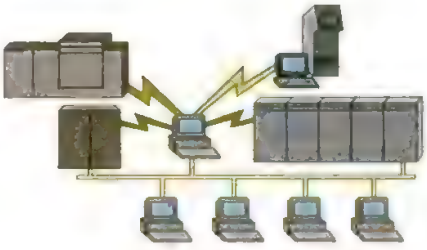

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PERFORMANCE TESTS: MCA MEMORY BOARDS

Our tests show that the difference between the top-performing MCA memory boards and the slowest entrants is almost nonexistent when it comes to reading blocks of data. But when the system is writing blocks of data to the board, there is a much greater difference between the boards with the fastest and the slowest throughput rates. The best performers are those that employ zero wait states and take advantage of system cache.

WHAT THE NUMBERS MEAN

Among the 11 MCA memory boards tested, the results on PC Magazine Labs' Memory Read and Memory Write tests were fairly consistent. The fastest boards read and wrote at zero wait states and took advantage of the Model 70's RAM cache. While the expansion boards cannot match the speeds achieved with motherboard memory, the decline in throughput was only about 20 to 25 percent.

Only a few products fell below the top range on one or both of the memory tests. The AMS Memory 32 DI, for instance, had trouble sensing 32-bit operations and defaulted to 16-bit speed. This, along with the board's operating at one wait state, resulted in poor performance for memory reads and memory writes. AMS identified a circuitry design problem and plans to correct it.

The CuRAM-MC32 performs memory reads at zero wait states. Cumulus says that its CuRAM *writes* to memory at one wait state, but our test results indicate that memory writes occurred at a slightly faster rate. This was possibly due to the CuRAM's use of system caching or Cumulus's employment of memory access techniques. But the CuRAM's throughput on our Memory Write test was still below that of zero-wait-state boards.

Orchid claims that its RamQuest 16/32 performs both memory reads and writes at zero wait states. The board's speed on the Memory Read test can be attributed to that use of zero wait states and to its use of system cache for memory reads. But its poor results on our Memory Write test imply that it does not use system caching for memory writes.

The Parity+Plus P32010 uses memory interleaving techniques that allow alternating banks of SIMMs to run at either zero or one wait state. This results in a hybrid memory access somewhere between zero and one wait state. The Parity+Plus also initializes memory after the host system's self-test, which on our tests prevented it from using system cache.

All boards passed PC Labs' test for LIM 4.0 Expanded Memory driver compatibility when using the DOS 5.0 memory manager.

HOW WE TESTED

For our MCA memory board tests, we used a 25-MHz IBM PS/2 Model 70-A21 equipped with 8MB of motherboard memory and a 64K RAM cache, and running IBM DOS 5.0 as the operating system. Each of the memory boards we reviewed included 8MB of 80-nanosecond SIMMs and was installed for 32-bit operation.

For comparison, as part of our test-bed, we also ran PC Labs' Memory Read and Memory Write tests on the Model 70-A21 motherboard. When run on the motherboard, the Memory Read and Memory Write tests accessed memory between 1MB and 8MB.

The **Memory Read** test performs memory reads in blocks of 4K; the test accesses memory in sequence from 0MB to 16MB. The results reported represent expansion board memory throughput as a percentage of motherboard memory throughput.

The **Memory Write** test performs memory writes in blocks of 4K; the test accesses memory in sequence from 1MB to 16MB. We do not write to memory below the 1MB boundary in order to avoid overwriting the operating system. The results reported represent expansion board memory throughput as a percentage of motherboard memory throughput.

Percentage of System Board Memory Throughput
(System board memory = 100)
Taller bars represent better performance.

INTEL CORP.
AboveBoard MC

If Intel Corp., the makers of the AboveBoard MC, may be accused of anything, it is misguided wizardry. Although the board shows the technical prowess of the semiconductor giant's design engineers, the board's advanced technology fails to make the AboveBoard MC more useful than any other MCA memory board. And it does make the board a bit more confusing to install. The board could also use better SIMMs.

Intel offers the AboveBoard MC in three capacities: with no memory for $399, with 1MB using 256K SIMMs for $599, and with 4MB for $999. It does not sell the board with 8MB. Adding 4MB more of RAM at a typical street price of $50 per megabyte would bring the unit to a total of $1,199.

The board itself can pack up to 32MB into any IBM PS/2 short of the Model 90 series. It is flawlessly laid out with only surface-mount components. It incorporates advanced technology in the form of an EEPROM that stores configuration information such as the addresses to use, matching the board to your system. The EEPROM allows the board to remember its configuration after the power goes off so that it does not have to rely on the limited battery-backed memory in a PS/2. But in testing the EEPROM required an extra configuration step to optimize the speed of the board, which led to POST memory-recognition problems.

The AboveBoard MC has nice features, including its EEPROM and a clean design, but it lacks flexibility in some respects.

INSTALLATION RESTRICTIONS

The constraints on the memory modules you can install on the AboveBoard MC are severe. All must have the same capacity, either 256K, 1MB, or 4MB SIMMs. These devices must be 1 byte wide plus parity (the board accepts both 9-bit linear and page-mode SIMMs, according to Intel). The sockets you use are strictly defined two-module banks for 16-bit PS/2s and four-module banks for 32-bit machines. Possible board capacities range from 512K (two 256K SIMMs in a 16-bit machine) to 32MB (fully populating the board with 4MB SIMMs). The evaluation board was equipped with eight 1MB SIMMs rated at 80 nanoseconds.

The Intel software configuration program, which adds an extra step to the normal MCA configuration process, allows the board to operate at either one or zero wait states depending on the speed of the SIMMs installed. Those with 80-ns. ratings should allow zero-wait-state operation, while slower SIMMs (up to 120 ns.) require adding a wait state. The AboveBoard MC using zero-wait-state operation was among the top performers.

Beyond memory, Intel also allows adding an optional $149 parallel port and serial port to the AboveBoard MC. In addition to setup and diagnostic software, Intel includes an EMS driver, print spooler, and RAM disk. The board is protected by a five-year warranty.

The AboveBoard MC has some nice features going for it, including its EEPROM and a clean design, but it lacks flexibility in some respects. If you are looking for a board with good performance and the assurance of a big name behind it, however, this one may be worth your consideration.

FACT FILE

AboveBoard MC
Intel Corp., 5200 NE Elam Young Pkwy., C03-07, Hillsboro, OR 97124-6497; 800-538-3373, 503-629-7354.
List Price: Without memory, $399; with 1MB RAM, $599; with 4MB, $999. One parallel and one serial port, $149.
Works With: IBM PS/2 Models 50 through 80.
In Short: The engineering feats of the AboveBoard MC include an EEPROM for matching it to your system, but the board is more constrained regarding memory module expansion than most systems we reviewed. Still, the AboveBoard MC measures up to the best in performance.

CIRCLE 416 ON READER SERVICE CARD

KINGSTON TECHNOLOGY CORP.
Kingston KTM 3011-4

Kingston Technology's Kingston KTM 3011-4 is a fast and optimal choice in the MCA memory board arena—if you can overlook some of the tallest list prices in the business.

The list price structure pegs Kingston as a company with a truly vivid imagination. The KTM 3011-4 sells for $1,450 with 4MB of RAM. Add another 4MB to make the 8MB tested configuration and the list price climbs to a whopping $2,425. But Kingston claims the street price will be more like $850 to $995—an unbelievable discount of almost 70 percent.

The KTM 3011-4's hardware is more down-to-earth than the board's pricing, and it is fast. The basic board can hold from 1MB to 16MB and can be installed in 32-bit PS/2s of the Model 70, 80 and 90 series. Kingston also offers a line of 16-bit boards for lesser PS/2s.

The KTM board is rigid in the way it requires you to install SIMMs in its four oddly placed sockets. The foundation board

CONTINUES

FACT FILE

Kingston KTM 3011-4
Kingston Technology Corp., 17600 New Hope St., Fountain Valley, CA 92708; 800-835-6575, 714-435-2600.
List Price: With 4MB RAM, $1,450; with 8MB, $2,425; with 16MB, $4,375.
Works With: IBM PS/2 Models 70 through 95.
In Short: The Kingston KTM 3011-4 boasts top performance on our tests and supports all advanced data-transfer modes. The oddly placed but functional sockets limit the KTM 3011-4 to accepting up to 16MB of RAM for the IBM PS/2 Model 70, 80, and 90 series.

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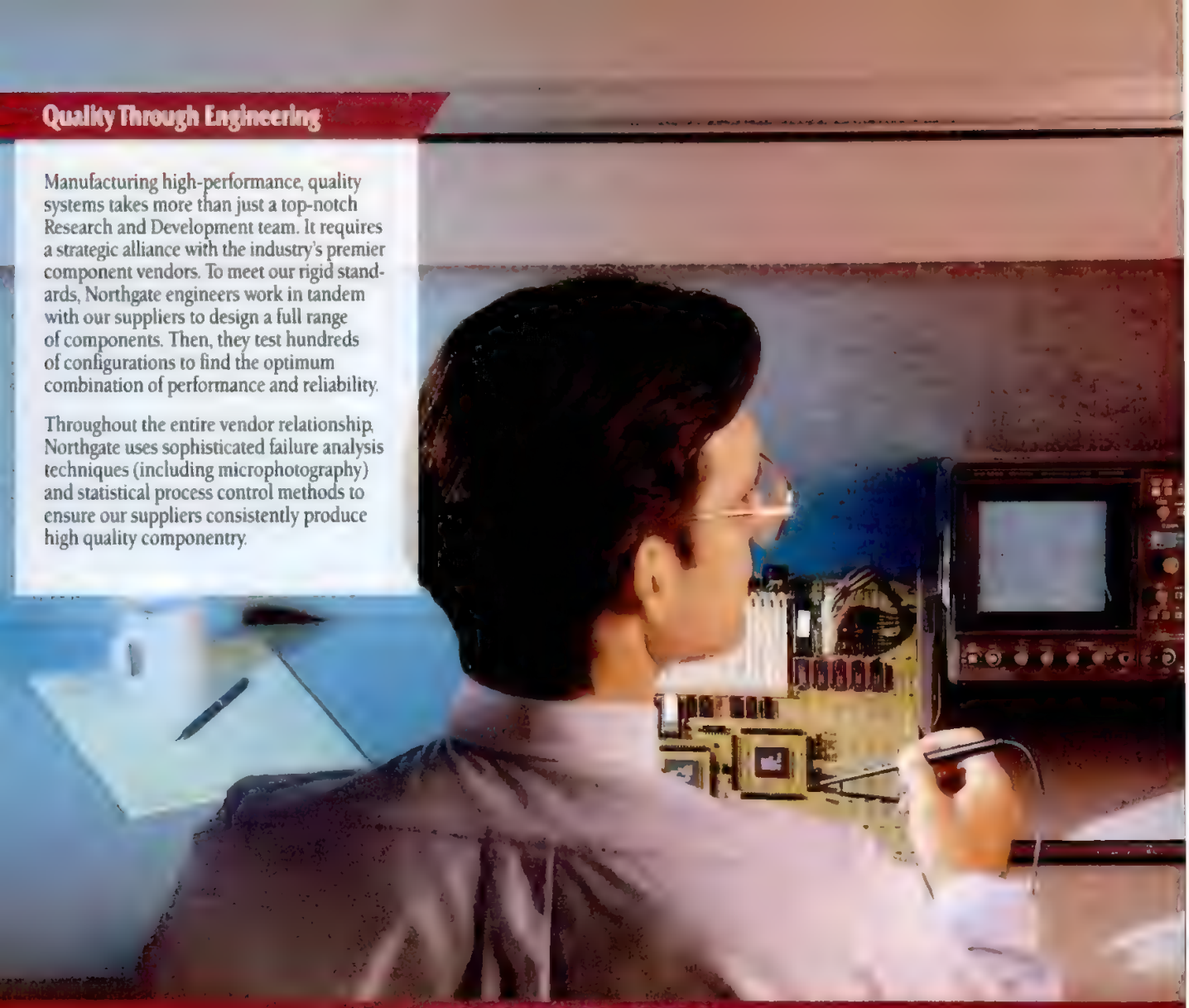

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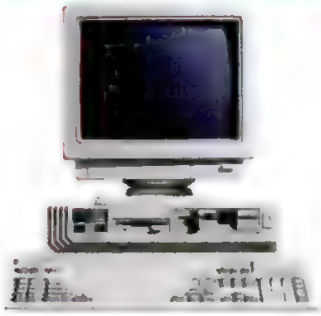

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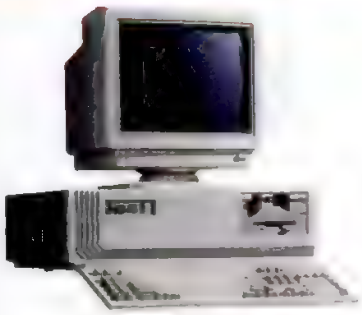

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- Independent Inverted T Cursor Control And Numeric Keypads
- Rate Select From 3-120 CPS
- Period/Comma Lock Key Locks out < > Even When Shifted
- Interchangeable CTRL, ALT, CAPS LOCK Keys
- Unmatched IBM® Compatibility
- FCC Class B Certified

$89.00

OmniKey/102
- 12 F-Keys On Left
- Alps Click/Tactile Key Switches
- Independent Inverted T Cursor Control And Numeric Keypads
- Rate Select From 3-120 CPS
- Period/Comma Lock Key Locks out < > Even When Shifted
- Interchangeable CTRL, ALT, CAPS LOCK Keys
- Unmatched IBM Compatibility
- FCC Class B Certified

$89.00

OmniKey/ULTRA
- 12 F-Keys On Left And Top
- Alps Click/Tactile Key Switches
- Independent Inverted T Cursor Control And Numeric Keypads
- Rate Select From 3-120 CPS
- Period/Comma Lock Key Locks out < > Even When Shifted
- Interchangeable CTRL, ALT, CAPS LOCK Keys
- Unmatched IBM Compatibility
- FCC Class B Certified

$129.00

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CIRCLE 368 ON READER SERVICE CARD

CODE A1402

CONTINUED

will accommodate 36-bit IBM-style SIMMs with 1MB, 2MB, or 4MB of capacity, but sockets must be filled in numerical order from one to four, with the larger-capacity SIMMs going into the lower-numbered sockets. The four 2MB SIMMs on the evaluation board were rated at 80 nanoseconds. These SIMMs were more than enough to help push Kingston's unit into the high end of the performance spectrum.

MEETING MCA STANDARDS

Kingston is one of those companies that take a step away from normal MCA board installation by requiring you to install first the software and then the hardware. (With most of the other boards, you can install the hardware first and then run the configuration software.) According to Kingston, the KTM 3011-4 supports all of IBM's advanced MCA modes, including streaming data, multiplexed data transfers, and bus parity.

Apart from the SIMM placement—three unequally spaced SIMMs on the left of the board and one on the right—the board's design and construction are good if uninspiring, all pin-in-hole. It is nicely laid out, with only one engineering change-order jumper. The board is backed by a five-year warranty.

If you can ignore the list price, the KTM 3011-4 offers good performance in a neat if oddly designed package.

MEMREL CORP.
Parity+Plus P32010

If you just want more memory without bells, whistles, or fire alarms, the Parity+Plus P32010, from Memrel Corp., may be what you are looking for. A basic memory board, the Parity+Plus adds only up to 8MB to PS/2 Models 70 and 80. (A companion product, the Parity+Plus P16010, adds similar capacities to 16-bit machines.)

The price is intriguing. A bare board lists for just $235. Filling it to 8MB, as in the evaluation board, pushes the price to only $795. Unfortunately, the performance of the Parity+Plus proved short of the mark.

Memrel is not stringent on the speed ratings of the SIMMs used with the Parity+Plus, and it allows just about anything rated faster than 150 nanoseconds. The evaluation board was equipped with eight 80-ns. 1MB SIMMs. Despite the fast rating of these SIMMs, the performance of the Parity+Plus was among the slowest tested.

> The Parity+Plus P32010—though not cutting edge—has excellent construction quality.

Eight SIMM sockets on the Parity+Plus accommodate byte-wide linear 256K or 1MB SIMMs with parity checking. The sockets are divided into two four-module banks, in each of which all modules must have the same capacity, although the two banks need not match. A single board can thus deliver 1MB, 2MB, 4MB, 5MB, or 8MB.

PIN-IN-HOLE BUT EXCELLENT QUALITY

Although the design of the Parity+Plus will not win any awards for cutting-edge technology (it is all pin-in-hole components dominated by two large ASICs), the construction quality is excellent. The board integrates into the IBM software configuration scheme using the Track Zero method to allow the system to recognize its memory at boot-up time. The only annoying feature is the speed at which the board's self-test counts through its capacity, adding an inordinately long delay to booting up cold.

Memrel supplies its own EMS driver, MEMRLEMM.SYS, to take advantage of the board's built-in translation RAM. The accompanying instructions are not easy to follow and are badly printed. The Parity+Plus is backed by a five-year warranty.

If you are willing to give up speed and some setup flexibility for a low price, the Parity+Plus is worth a look.

FACT FILE

Parity+Plus P32010
Memrel Corp., c/o SGS-Thomson, 1000 E. Bell Rd., Phoenix, AZ 85022; 800-255-2328.
List Price: Without memory, $235; with 2MB RAM, $395; with 4MB, $535; with 8MB, $795.
Works With: IBM PS/2 Models 70 and 80.
In Short: A reliable board that can add up to 8MB to PS/2 Models 70 and 80, the Parity+Plus P32010 falls a bit short in performance, capacity, and integration.

CIRCLE 418 ON READER SERVICE CARD

ORCHID TECHNOLOGY INC.
RamQuest 16/32

Orchid Technology's RamQuest 16/32 offers you added value in the parallel and serial ports it provides as standard equipment (along with a 6-foot adapter cable). But the board is not as generous in other respects. It lets you add only up to 8MB of RAM to your PS/2, and its performance is not top-tier. The RamQuest matched the competition in memory read times but proved truly laggardly in memory writes.

The basic RamQuest, with ports but shorn of memory, lists for $349. Add the full 8MB capacity and the price climbs to $1,229. The board can slide into either 16- or 32-bit MCA computers.

Memory can be added in the form of up to eight readily available 9-bit SIMMs. Either 256K or 1MB modules qualify. The byte-wide modules must be installed in pairs of the same size and speed for 16-bit transfers and in banks of four for 32-bit transfers. Within those limitations, you can mix 256K and 1MB chips on the board. The evaluation board was equipped with 80-nanosecond RAM, which should deliver zero-wait-state operation.

In testing, however, zero-wait-state operation could not be confirmed. While the RamQuest was among the fastest boards in read performance, it proved among the slowest of all boards tested in memory writing.

On the other hand, its construction quality rates as very good. The board is built from a mixture of pin-in-hole and surface-mount components dominated by a

FACT FILE

RamQuest 16/32
Orchid Technology Inc., 45365 Northport Loop West, Fremont, CA 94538, 510-683-0300.
List Price: Without memory, $349; with 1MB RAM, $459; with 2MB, $569; with 4MB, $789; with 8MB, $1,229.
Works With: IBM PS/2 Models 50 through 80.
In Short: The RamQuest 16/32 can add a parallel and a serial port—but only up to 8MB of RAM—to any PS/2 short of a Model 90. Its main flaw is slow memory-write speed. With its combination of pin-in-hole and surface-mount components, the RamQuest is well constructed, if not state-of-the-art.

CIRCLE 419 ON READER SERVICE CARD

large, proprietary ASIC. On the card retaining bracket, the RamQuest offers a miniature DIN connector with a proprietary pin-out for the serial port and a female 25-pin D-shell connector for its parallel port; hence the necessity of the included adapter cable, which terminates in a standard male 25-pin D-shell.

TRUE INTEGRATION

The RamQuest integrates well with the IBM software configuration process, requiring only that you copy the option disk before you install the Orchid hardware. Once the board is set up, without jumpers or DIP switches, it mates perfectly with the IBM POST procedure.

Orchid supplies an EMS driver, RAM disk, disk cache, and a set of printer tools (including spooler) along with the adapter description files on the accompanying floppy disk. The instructions are particularly clear and well organized.

Orchid guarantees the RamQuest's compatibility with IBM PS/2 Models 50, 50Z, 60, 70, and 80. The board has a two-year warranty, which Orchid extends to four years when you return the warranty card. If you can overlook the write-speed flaw, the RamQuest is a well-made, affordable way to add RAM to any PS/2.

TECMAR INC.

MicroRAM SC
MicroRAM 386

Although they may cost more than some of the competition, the pair of memory expansion boards from Tecmar rank as two of the best that you can add to your PS/2. The MicroRAM SC and the MicroRAM 386 combine top speed, good workmanship, and excellent integration with the IBM standard.

Of the two, the MicroRAM SC is more versatile; it is compatible with any PS/2 from Model 50 upward. It is also more affordable, listing for $360 without memory—which is how Tecmar prefers to sell it. The company will add SIMMs for $100 per megabyte, making the 8MB board cost $1,160, although you can do much better if you add the memory yourself.

The MicroRAM 386 is more limited in application, rated to fit only 32-bit PS/2s, Models 70 through 95. The board lists for $390 without memory. Adding 8MB pushes the price up to $1,190.

The MicroRAM SC uses IBM-style (36-bit, 72-pin) system board SIMMs in any combination of 1MB, 2MB, 4MB, and 8MB capacity. Using 80-nanosecond SIMMs, the MicroRAM SC operates with zero wait states; with 100-ns. or 120-ns. SIMMs, it imposes one wait state.

> The Tecmar MicroRAM boards rank as two of the best that you can add to your PS/2.

The MicroRAM 386 accommodates up to eight fast page-mode SIMMs with capacities of either 256K, 1MB, or 4MB. Due to the board's 32-bit design, SIMMs must be installed in banks of four of equal size, allowing total board capacities of 1MB, 2MB, 4MB, 8MB, 16MB, or 32MB. The board accepts 85-ns. or faster SIMMs for matched memory operation, 100-ns. SIMMs for zero-wait-state operation, and 120-ns. SIMMs for one-wait-state operation.

On our tests, both boards were equipped with 80-ns. SIMMs and delivered top performance.

Both of Tecmar's boards integrate with IBM's automatic configuration system and link to the host system without needing Track Zero support. The MicroRAM SC adds an automatic SIMM search routine to the configuration process, posting on the screen its run-through of sockets and chip capacities.

FACT FILE
EDITORS' CHOICE

Tecmar Inc., a division of Rexon Corp., 6225 Cochran Rd., Solon, OH 44139; 800-624-8560, 216-349-1009.
MicroRAM SC
List Price: Without memory, $360; with 8MB RAM, $1,160.
Works With: IBM PS/2 Models 50 through 95.
In Short: One of the best memory boards to add up to 32MB to any PS/2, the MicroRAM SC is as fast as the MicroRAM 386 and more versatile. The MicroRAM SC offers the same high-quality integration as its sibling, and it adds an automatic SIMM search routine to the configuration process. Though not the least expensive board reviewed here, the MicroRAM SC provides a range of features that warrants the investment.
MicroRAM 386
List Price: Without memory, $390; with 8MB RAM, $1,190. One parallel and two serial ports, $120
Works With: IBM PS/2 Models 70 through 95.
In Short: The MicroRAM 386 is a fast, well-built memory board that can add up to 32MB to any 32-bit PS/2. It offers excellent integration and workmanship.

CIRCLE 420 ON READER SERVICE CARD

MORE I/O PORTS

The MicroRAM 386 also includes a 44-pin header, to which an optional $120 port board can be attached to add one parallel and two serial ports to your PC.

On both boards, most of the circuitry is surface-mounted, with the MCA interface developed in a Xilinx ASIC. While the MicroRAM 386 squeezes into just over 0.6 inches of slot, the MicroRAM SC fills the full 0.8-inch slot space, chiefly because of the wider 36-bit SIMMs. In addition to configuration and diagnostic utilities, Tecmar includes a print spooler and RAM disk with its MicroRAM boards. Inexplicably, these boards have niggardly two-year warranties.

While either Tecmar board will add fast, high-quality storage to your PS/2, the MicroRAM SC is the better choice: It's more versatile and more affordable. In fact, the MicroRAM SC—with its standard integration and configuration procedures, flexibility regarding memory, and good performance—is one of the best choices you can make from among all the memory boards reviewed here. ■

Winn L. Rosch is a contributing editor of PC Magazine.

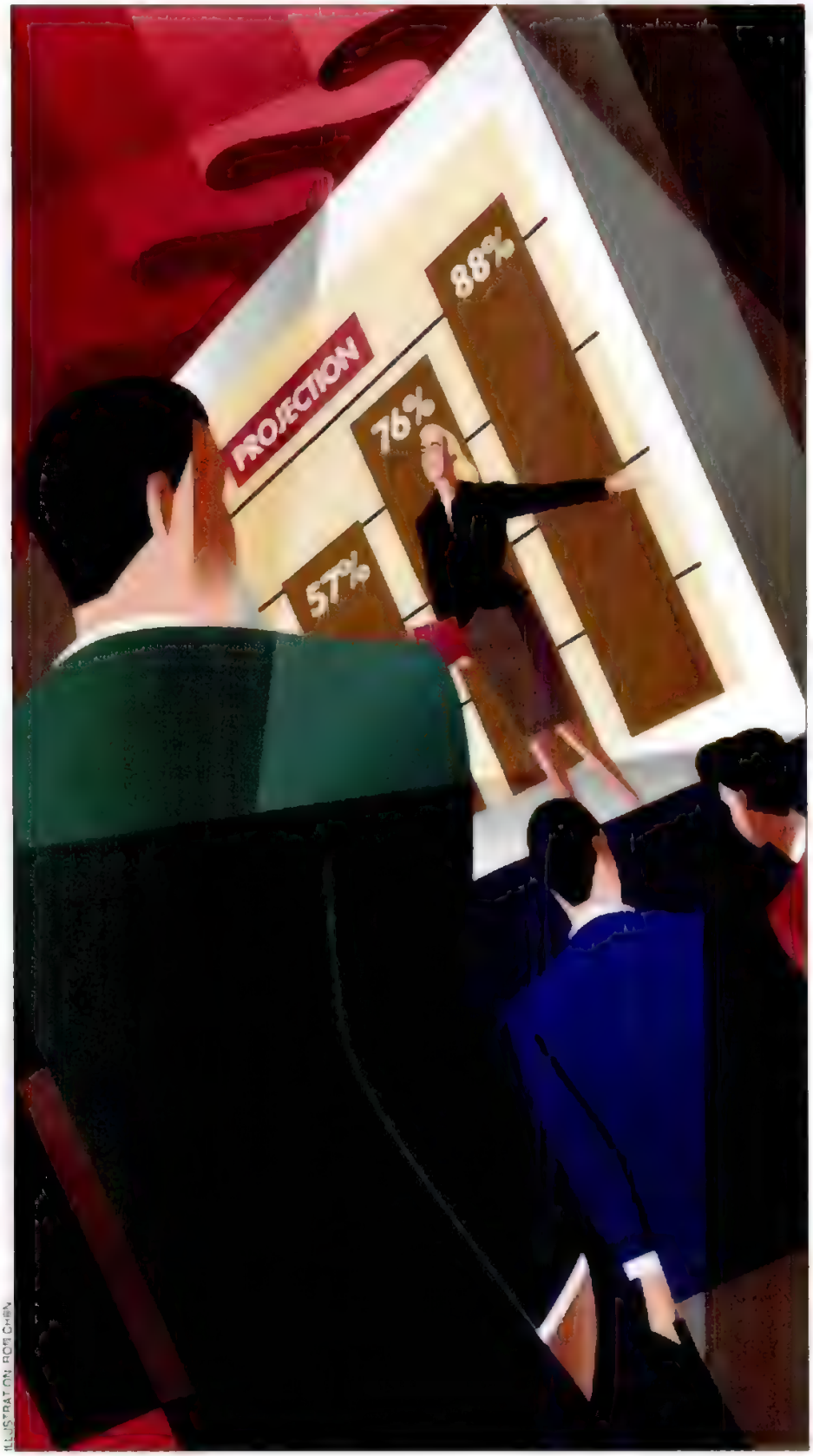


ILLUSTRATION: ROB CHEN

12 Tips for Better Presentations

Presentation graphics programs are difficult to use. You can't change them, but you can work smarter. Here's how.

by Gus Venditto

It's ironic. You devote long hours to mastering every facet of your job, creating artfully crafted spreadsheets and databases in solitude. Yet your reputation rides on none of that. The fate of your projects—indeed, your career—rises or falls on the visual quality of the presentations you make.

It doesn't matter how much work went into assembling your information;

your audience knows only what it sees. And if you are like most people, you do not have nearly enough time to prepare your graphics. You probably set aside about an hour to prepare the ten or more slides you need—and you only begin the job when you're as close to the meeting as your slide-making service's turnaround times allow.

The single ingredient that is needed for every good presentation is the one thing you cannot requisition with a three-part form: time. In addition to the time you need for planning and writing your comments, you have to devote time to gathering, analyzing, and massaging your data. You have to cut large spreadsheets into pieces for the handful of figures you need. You have to scan in logos and then touch them up with paint programs. And only then are you ready to start working with your presentation graphics software.

By the time you begin running *Harvard Graphics, Freelance Graphics for DOS*, or whichever program you use, you may feel as if you had done enough work to prepare two presentations, but you're just beginning. Now you have to choose fonts and colors. You need to create a design: Should everything be centered or flush left? Will you number your points or use bullets? Should the company logo appear on each screen?

With so many points to consider, you start to think that maybe you don't need graphics that badly. But, of course, you have to bring them if you want to keep the audience riveted. After all, your competitors will have them. Whether your graphics are displayed as laser-printed handouts, overhead transparencies, or full-color projected images, desktop presentations are becoming increasingly important as a way to prove that you have done your homework, have a convincing case, and are dedicated to your projects.

Since presentation graphics programs are so rich in features, few people have the time to learn them. Software publishers are responding to this problem. You can expect to see future packages become easier to use, even as features are added. Some vendors are already making templates (or masters) central to their programs' design, simplifying the work you need to put into your slides' appearance. And the future products will make it easier to link charts with original data, so you can spend less time updating individual graphics.

In the meantime, *PC Magazine* is doing its part to help you work smarter. We contacted several authors of books on presentation graphics products to get a blend of innovative ideas and suggestions for improving the productivity of your graphics package. The tips start out with simple ideas, techniques that you may be using now, and move on to some tricks that you may never have considered. Some of the tips offer detailed instructions on a particular program, such as market leaders *Harvard Graphics* and *Freelance Graphics for DOS*, but most have broad application for use with any software, including *Aldus Persuasion, Charisma*, and *Microsoft PowerPoint*. There is even a tip to help you get all the slide-making help you need from *Quattro Pro*.

It's worth spending the time to master your presentation graphics software. With higher-resolution video and cheaper scanners in the offing—not to mention the extra dimension that audio will provide as multimedia boards become more common—desktop presentations will become even more important. And the time you spend learning how to work with your presentation graphics package now, before the next meeting, will pay off in the long run.

OUR CONTRIBUTORS

Gus Venditto is an executive editor of *PC Magazine*. He writes the Pipeline column and is the author of the forthcoming *PC Magazine Guide to Windows* (Ziff-Davis Press).

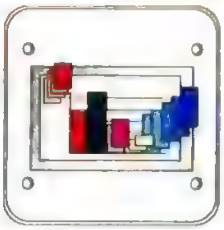
Mary Campbell is the author of *Harvard Graphics Made Easy* (Osborne/McGraw-Hill), *The Quattro Pro Handbook* (Bantam Books), and more than 20 other books.

James Meade, Ph.D., is the author of numerous books and articles on graphics, including *Using Freelance Plus* and *Using PowerPoint* (both from Que Corp.) and *The First Book of Freelance Graphics for Windows* (to be published by Howard W. Sams & Co.).

Roger C. Parker is a consultant on desktop publishing and is the author of *PowerPoint Presentations by Design* (Microsoft Press), from which his tips were adapted.

Templates Save Time and Control Quality

by Mary Campbell



Although it's a good idea to vary the types of charts you use from slide to slide, maintaining some consistency across the presentation is important. When designing a presentation, your goal should be to make the individual slides seem part of a coherent whole rather than a string of unrelated graphics. One way to accomplish this is by adding some distinctive element to each of the slides; for instance, a company logo or department name. Another way is to use the same format and color palette throughout the presentation.

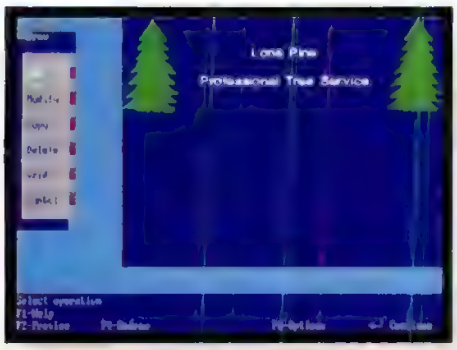
Templates can do both, while alleviating the repetitive work that might otherwise be required to place such elements on all your slides. Most presentation graphics packages include some facility for working with templates, but they all use different techniques. *Aldus Persuasion* calls templates *masters* and provides both background and slide masters. You can bring in masters using the Import Master command on the File menu and control them with dialog boxes that you run from the Go to Slide Master command on the View menu. In *Microsoft PowerPoint*, you use Slide Masters, which you open and change using the Slide Master command on the View menu. You can also use the settings for old presentations as masters by selecting the Use Format of Active Presentation option in the File New menu command.

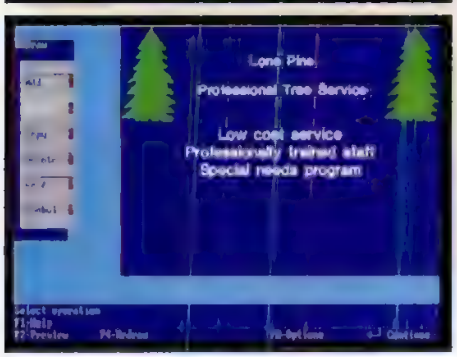
In Software Publishing Corp.'s *Harvard Graphics*, creating a template is really no different from creating any other type of chart except that you do not enter any data specific to the slide; you just enter the supporting titles and graphics. You still begin by telling *Harvard Graphics* that you want to create a particular type of new chart, then make any additions you will want to see on all charts of similar types.

To create the first Title Chart containing the template information, select Get/Save/Remove, then choose Get Template and the desired template's name. You can then enter data as normal on the Title Chart. To save your completed template, simply choose the Save as Template option from the file menu. *Harvard Graphics* adds a .TPL extension to the filename.

The template shown in the slides below was created as a Title Chart with additions made to it in *Harvard Graphics*' Draw/Annotate screen. Symbols and text were inserted and positioned as they would normally be in the slide.

You can also use templates to create consistency in a ScreenShow. Start by creating a free-form Text Chart template, which allows you to establish chart size and placement (choose F7 from the Main Menu, then save these changes with the template); you can also create titles, subtitles, and footnotes. Any drawings you place on the free-form chart from the Draw/Annotate screen will be carried forward to other charts in the presentation, which makes this an ideal way to customize your ScreenShow with a company logo. To jazz up your ScreenShow a bit further, consider using the *Harvard Graphics* button feature with your templates. This feature lets you press a special key or click a button on a chart to control your progress through the show.

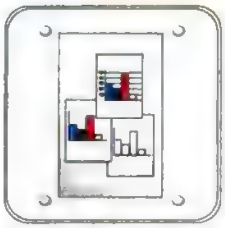




Templates (or masters) are one of the most time-saving techniques you can use when creating a presentation. The screen at top is a template for the screen below, which was created by adding text to the template.

Harvard Graphics has reserved button numbers 211 through 217 to perform a consistent function throughout a show. These special button numbers automate tasks such as returning to the previous slide, advancing to the next slide, moving to the first or last slide, pausing, or quitting the show. Once you create these buttons on a template with the Draw/Annotate feature, they are ready to be used without the HyperShow linking required for other buttons.

Build Your Argument One Slide At a Time



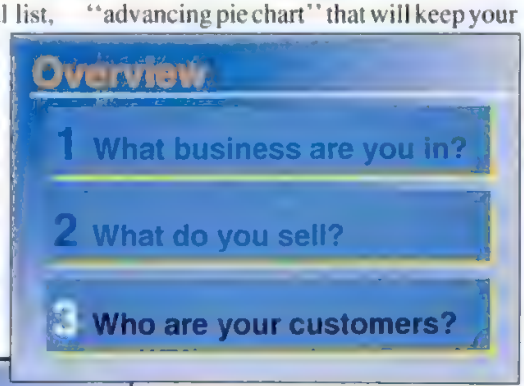
by Roger C. Parker

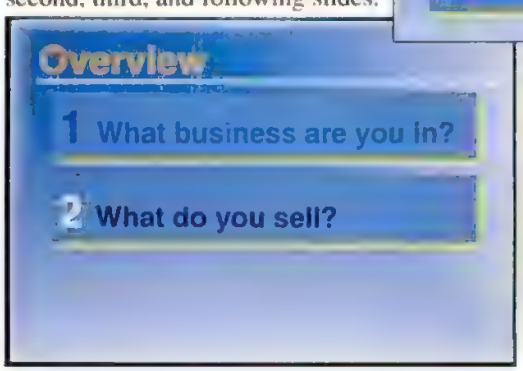
Having trouble keeping all the members of your audience focused on the same point? Try building up complex presentations one step at a time, to keep the audience from reading ahead of your discussion. By building your presentation, you help focus audience interest on the point you are currently discussing and, as a bonus, add movement to your visuals.

Building is a great technique for introducing lists, charts, or illustrations one element at a time. You can create the effect with the layering option built into some presentation graphics programs or by using the following technique: To create a text build, start from the finished product. Complete the final list, chart, or illustration, then use the copy and paste commands to make a copy of the slide for each element in the build. (Another option is to edit the presentation list to duplicate the final slide several times.)

After you have made the appropriate number of copies, go back to the first slide in the series and delete the items that will be added in the second, third, and following slides. When you have finished deleting, recolor the first build element in your foreground color.

Go to the next slide and repeat the procedure, deleting items that will be added in successive slides. This time, instead of recoloring the first element in your foreground color, put it in a subtle color (such as gray) that will complement the foreground shade. Recolor the newly introduced element in the foreground color. Repeat this process for the following slides, using color to de-emphasize previously introduced elements and emphasize the newly introduced element. If you follow this approach, you can easily orchestrate your audience's attention, keeping members with you as you discuss each element, while making it easy for them to review previously introduced points.





Building a topic is more effective than listing all the points on a single slide. To create a build, you start with the final slide and then work backward. Note how the change in color from item 2 (left) to item 3 (above) helps accentuate the point.

Use an Advancing Pie Chart to Pace Your Presentation

by Roger C. Parker

Audiences tend to be impatient, especially if they don't know how much longer your presentation is going to last. To keep your audience informed of your progress, you might try using a pie chart that simulates a moving clock.

You can use the graphing feature in most presentation programs to create an "advancing pie chart" that will keep your

audience informed of where you've been and how much more needs to be covered (see examples below). This technique works equally well in black-and-white and color slides.

To start, divide 360 by the number of slides to be included in your presentation. Enter this number in your presentation program's datasheet or worksheet and create a pie chart (in *Harvard Graphics*, select Create Chart from the main menu). Then copy the pie into one of your slides and size it to fit.

You will want to make many copies of this small pie; ultimately the color of one slice in each pie will be distinct from the others. Looking at the first pie as a clock, change the color of the slice in the first time slot (12:00 to 1:00, for example) to match your background; all other slices should be the same color as the text.

In Windows presentation graphics products, you can use the Clipboard to cut-and-paste the pie chart into a slide. In *Harvard Graphics*, you will need to save each slice as a symbol and insert it using the symbol tool. In Lotus's *Freelance Graphics for DOS*, you can use Delete and Undelete to create the individual slices and insert them one by one, but it would be more efficient to create a symbol set for the entire series of pie slices. When you have finished recoloring the pie-chart slices for each visual, save the presentation as a template so you can easily reuse it the next time.

This technique also lends itself to a variety of options. For instance, you can emphasize the pie chart by adding a box around it, or highlight the current pie-chart slice by making it the same color as the title. You can also add a list that summarizes the titles of previous slides to the left of the main points. Finally, if you want to weight the pie-chart slices based on relative importance, you can make some larger than others.

Create Logical Groups of Slides so You Can Recycle Presentations

by James Meade and Gus Venditto

Often, presentations are not created from scratch; they are re-created from existing slides. If you are putting together a presentation for a departmental meeting, you may want to use the title page created for the last departmental meeting, a bar chart on last year's results, a few line charts showing trends in different regions, and a newly created hi-lo-close-open chart showing how the company's stocks are doing.

The job can take far longer than it should, because most presentation graphics programs have limited tools for helping you mix and match slides. And if you keep updating your charts, there is often no way to be sure that the chart you choose is the most recent—short of looking at all existing versions. The result is that you spend a lot of time looking at old slides before you can build your new show.

An advancing pie slice can be used to give your audience an idea of how your slide show is progressing. You create the effect in the upper-left corner of each of these slides by coloring slices of the pie.

Freelance Graphics for DOS offers one of the best solutions to this problem. The Portfolio feature lets you list up to 100 slides, with their filenames and directories. You can update the drawings whenever you want; each time you update a graphic listed in Portfolio without changing its filename and directory, the updated file automatically becomes the one listed in Portfolio. You will get the best use from this feature if you keep a master Portfolio file (perhaps named MASTER.PFL). All presentations using the master file are linked.

Whenever you want to clone original charts and drawings for specific presentations, create a copy of MASTER.PFL and give it any name you want, perhaps SALES.PFL. In the new Portfolio file, use Range commands to delete the files you do not plan to use and to rearrange the others. Using this approach, you're half done before you begin. You can then create whatever new drawings you wish, using the chart and drawing commands from Portfolio.

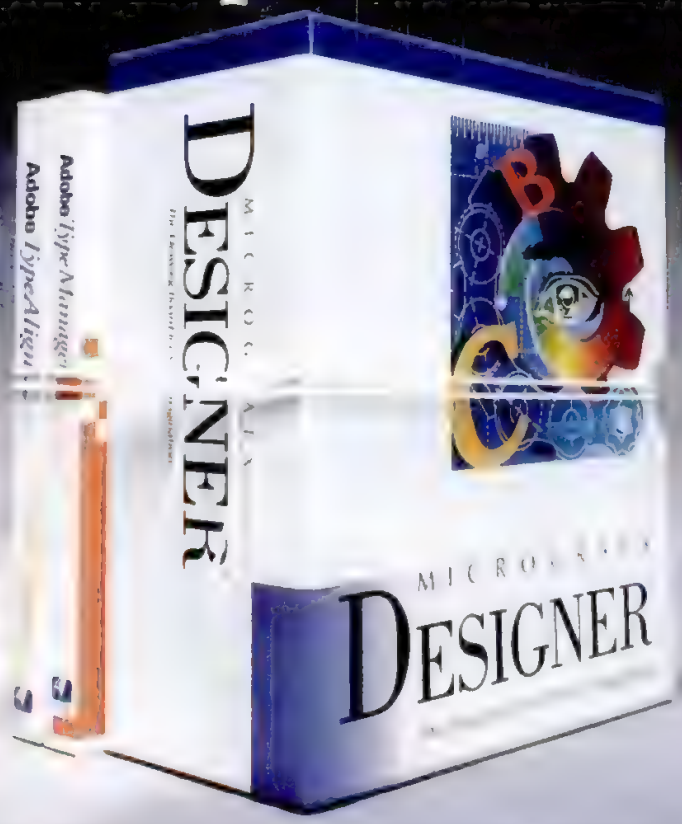
As long as you do not change the filename and directory for those drawings you recycle, and as long as you keep the drawings in that one master Portfolio file, you will always be able to find them, and they will always be up to date.

Other presentation graphics products provide ways to build new presentations from the pieces of old ones, although you will find them less elegant to use than *Freelance Graphics for DOS*'s Portfolio. In *Harvard Graphics*, you can edit existing slide shows and save them with different names. Then you can add and delete slides or nest one presentation within another. Nesting gives you the ability to create and design bits of presentations that can be used interchangeably in larger shows.

You nest presentations in the Edit Presentations menu by adding a .SH3 Present file to a new presentation's list of files. The entire presentation, not just one slide, will run. You can create one presentation that consists of several others, but you cannot nest a presentation within one that is already nested. You can nest only one level deep.

In both *Aldus Persuasion* and *Microsoft PowerPoint*, you merge slides from one presentation into another by copying slides to the Clipboard in the Slide Sorter view and then pasting them into the new presentation. In Micrografx's *Charisma*, you can add slides to an existing script using the Edit menu's Add command.

The World's Top-Rated Illustration Software Is Getting Some Impressive Letters.



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Designer system requirements: 286 (386 recommended) IBM PC or compatible, or PS/2. 1 MB RAM (2 MB RAM recommended). 20 MB (or larger) hard disk. Windows 3.0. DOS 3.1 (or higher). Mouse or digitizing pad. Windows-compatible monitor.

When Addressing a Big Audience, Use Big Type

by Gus Venditto

You may have 20/20 vision or better, but chances are that not everyone in your audience does. If you are going to be showing slides or transparencies in a large room, take some time to make sure your fonts are large enough to be read from a distance.

When you think your slide is done, have it imaged and test your presentation by projecting it from across your conference room. Can you read the fine print? The last thing you want to see when you're making your pitch is a lot of squinting. Titles work best at about 24 points or bigger, subtitles at 18 points, and body text at 14 points.

Be especially careful when selecting point sizes for legends and footnotes. If you are citing an authoritative source, you want to make sure people can see the name. Otherwise, they may regard your data as suspect simply because they can't read your 8-point type.

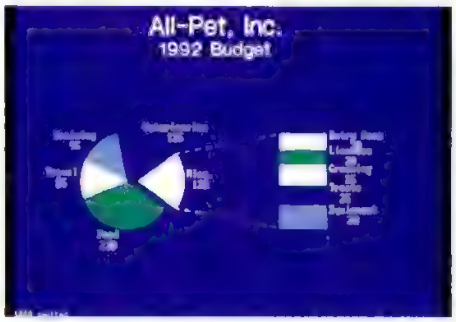
Use *Harvard Graphics* to Show the Detail Behind One Slice in A Pie Chart

by Mary Campbell

If you are trying to show a number of individual items in relation to the whole, you will probably choose a pie chart. This type of chart is perfect for depicting such things as budget expenses or the breakdown of sales among products—cases where you want to show how important each item is to the total picture.

Unfortunately, it's easy for the big picture to grow too crowded. If you have ever created a pie chart with many small pieces, you know that it is virtually impossible to label all those little slivers. You've probably resorted to grouping some pieces into a miscellaneous category or substituting a different chart type altogether, but those compromises usually mean losing some important detail.

A better solution is to link your pie chart to a second pie chart or a column chart that shows expanded detail for an individual slice of the pie. This means that you will need to enter two sets of data values. In *Harvard Graphics*, you enter the data for your first pie chart as usual and then press PgDn to enter the data for the second pie. To link the two charts, you simply go to the Pie Chart form, press F8 (Options), then choose Yes for the Link

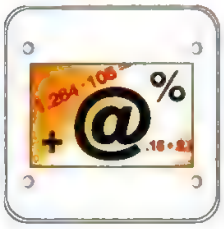


Pies feature. You can change other aspects, such as the sequence of slices, by pressing PgDn.

There is no reason, however, to stick with a pie for your second data chart. It's just as easy to turn the second chart into a column chart: Just press F8 from the Pie Chart form, change the chart style for pie 2 to Column, and you're linked and ready to roll.

Avoid Recalculations in *Harvard Graphics* by Using Keywords

by Mary Campbell



Although you may pride yourself on planning so well that your data will stand the test of time, conditions change, and you may eventually want to conduct an analysis that requires you to enter different numbers. Before entering any new data, consider using *Harvard Graphics*' keywords to perform mathematical or statistical computations on row values or series of data. These computations can create new data series for display on a chart. You won't have the flexibility to perform computations for a single cell—as in a spreadsheet—but you can use mathematical operators to build a new column of data based on the existing columns.

If you need to add the row values from up to seven data series, you can use the @SUM keyword solution. When you enter the formula, use a number sign followed by the series number to represent the values in a particular series; for example, you would type @SUM(#1,#2) to total two data series.

Don't try to cram in too much detail. You can often break out the figures for one segment as a secondary chart instead of slicing the pie too thin. The secondary chart can be either a pie chart or a stacked bar.

Other keywords work with a single series to create a new series from the original values. For example, @CLR clears the values from the original series, @EXCH exchanges the values and legends for two series, and @PCT calculates the percentage contribution of each value to a total.

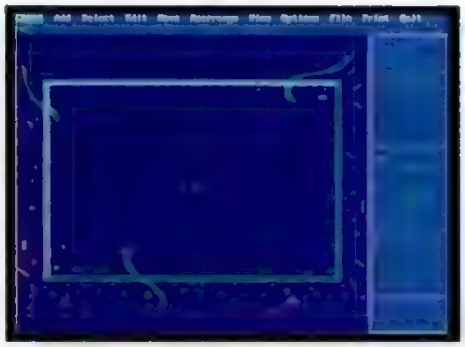
Using Backdrops for a Consistent Look in *Freelance Graphics for DOS*

by James Meade

If you are collecting your *Freelance Graphics for DOS* slides for Portfolio from multiple sources, you might have a title page that uses a blue background, a bar chart of regional sales results that sports a nifty pink hatched background, a couple of slides with no background, and some where you can't quite make out the background. When you combine them neatly into one Portfolio file, you will have a single presentation; unfortunately, the resulting jumble of backgrounds will be sure to offend even the least critical member of your audience.

Stick with choices that provide contrast not just in color but also in luminance.

Many presentation graphics programs have single commands that fix this problem by unifying the colors or fonts throughout an entire slide show; in *Harvard Graphics*, you achieve this with the Options menu. *Freelance Graphics for DOS*, Version 4.0, lets you specify a professionally created backdrop and automatically apply it to all the graphics in a Portfolio file. The key is to use Portfolio for the multiple files in your presentation. To use a backdrop, choose one from the collection of presentation templates on Symbols disks 4 and 5 (the manual has thumbnail sketches of them), and type in the path and filename for the backdrop near the top of the Portfolio list file. If you want a graphic to appear with the backdrop, simply go to



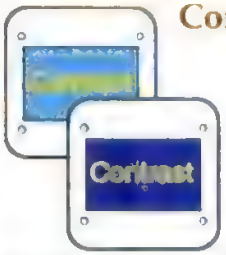
A backdrop can be simple or creative, as long as you keep it consistent from slide to slide and change it only when you want to create a particular effect.

the Print column and choose "Yes w/ Backdrop File." If you have already added a backdrop to a graphic manually, you will have to delete it. If you want to revise a graphic, highlight it and choose Charts and Drawings. The backdrop will be visible as you work.

A word of caution when using a backdrop: Don't set a different palette for an individual graphic. The palette for a graphic takes priority over the backdrop, thus changing the backdrop's colors. To establish consistent backgrounds throughout, base the color palette for your drawings on the backdrop file. If you have a graphic with a different palette, you will need to change it. Retrieve one of your drawings and make sure the graphic looks the way you want it to. Change Print Options to Current Settings, then resave the drawing.

Repeat this process for each graphic in the Portfolio and you will reach your goal—a visually unified presentation.

Choose Combinations that Contrast in Both Color and Brightness



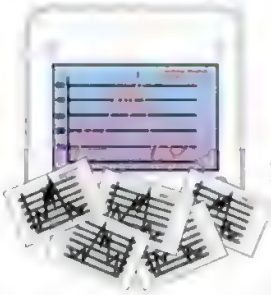
by Gus Venditto

VGA screens are enticing. The rich blues and deep reds they display enliven data that would otherwise seem dull. And the ease with which presentation graphics programs let you choose colors will tempt you to try ever bolder, more elaborate color schemes. But unless you are sure you'll be displaying your show on a computer monitor, don't get carried away. The general rule is: The simpler the better.

Blue text on a black background may seem a refreshing change from standard color schemes, but from the back of a conference room, your carefully chosen words may just blur into a giant Rorschach blot. Try to stick with choices that provide clear contrasts not just in color but also in luminance (the amount of light the color displays). For example, bright yellow text on a bright blue background is a clear color contrast, but it's hard to read; bright yellow on dark blue is easy to read, because the two shades contrast in both color and luminance.

This general rule is especially important when the slides are converted: The transition from disk to slide is more an art than a science. Midtones can easily become lighter or darker in the conversion, depending on the quality of the work done at your slide service. When you find a color scheme that works, stick with it—and with the slide service that produced it. Unless you have plenty of time and money to redo slides, you don't want to run the risk of last-minute surprises.

Changing from Color to Black and White in *Freelance Graphics for DOS*



by James Meade

Like most presenters, you probably spend a lot of time devising an attractive color scheme optimized for outputting to an HP plotter, or a color PostScript printer, or a film recorder—all of which have device-specific drivers for use with *Freelance Graphics for DOS*. If you don't change the original colors and tints, files slated for one device switch properly to other devices. Once you have changed the defaults, though, there is no telling what will happen if you output to a different color device or make the switch to black-and-white output for handouts.

About 90 percent of the time, you can output the old file to a new device with no problem. But sometimes the colors that looked so good with the first device become shades that bear no resemblance to what you intended.

To avoid problems, change your defaults as little as possible from one graphic to the next. It may be tempting to customize your own palettes, but this can cause all kinds of problems for your output devices. As long as you're working with uniform default fonts and colors, you can change output devices almost at will.

There is another solution that will let you change the defaults without creating output nightmares. The answer, once again, is Portfolio.

Let's say you want to print a Portfolio file of slides in black and white on your laser printer. First, open the file and load one of the graphics on the drawing page, then select Print, Options. Specify "black-and-white output device" and change the Read Options from "saved file" to "current settings." Then turn to the drawing page. Check to see whether the gray scales all look good; if one graphic uses an ineffective gray scale, then change the scale from the Print, Options color menu. When everything looks good, choose Print Go, and *Freelance Graphics* will optimize all the drawings in the Portfolio file for the new device. Now you will be able to take advantage of the fonts and shading

capabilities of the specific printer.

When you finish printing, remember to change "current settings" back to "saved file." Otherwise, all your subsequent files will appear in black and white when you retrieve them. You can change the drivers for Windows programs using the Printer Setup dialog box.

Fast Updating in *Freelance Graphics for DOS*

by James Meade

Updating and printing a large volume of spreadsheet-linked charts need no longer be unbearably tedious, if you organize your presentations with *Freelance Graphics for DOS*'s Portfolio and use the new Autocharting option. A popular feature in *Lotus Graphwriter II*, Autocharting has made its way into *Freelance Graphics for DOS* for the first time in Version 4.0.

Autocharting is particularly useful if there is information you need to distribute on a daily basis. It can be time-consuming to retrieve and update the charts each day and print them one at a time. Autocharting speeds up this process by automating updating and printing.

To use Autocharting, set up your links between charts and spreadsheets from within *Freelance Graphics for DOS*'s charting module using Datalinks. You can link to any *Lotus 1-2-3* spreadsheets (Version 2.01 and later) or to *dBASE*, ASCII, or SYLK files. Unfortunately, *Microsoft Excel* and *Quattro Pro* files are not compatible.

You can have multiple charts (linked to multiple versions of spreadsheets) on a single printed page, but you should limit yourself to four linked charts per page to avoid overcrowding. All *Freelance Graphics* links to spreadsheets are actually hot links, so when you retrieve a chart, you automatically bring in the latest data from the spreadsheet. Once you have set up the links, you can establish a "factory" for updating and printing the linked files. The key is to set up the linked charts in Portfolio. You can have 100 chart pages in Portfolio, each with up to 4 charts, so you can update and print up to 400 charts.

To get the factory in gear, type Autopfl and the name of your Portfolio file at the DOS prompt. *Freelance Graphics* will update the links, recompose the charts on the page if necessary, and print them to the device you specified in Portfolio. If you want to automate the process further, you can print thousands of charts consecutively by using a simple DOS batch file to execute several Portfolio files in succession. To achieve the same results in other presentation graphics programs, you'd need a very sophisticated macro.

Once you have set up Freelance Graphics links, you can establish a "factory" for updating and printing linked files.

Creating a Slide Show in *Quattro Pro*

by Mary Campbell

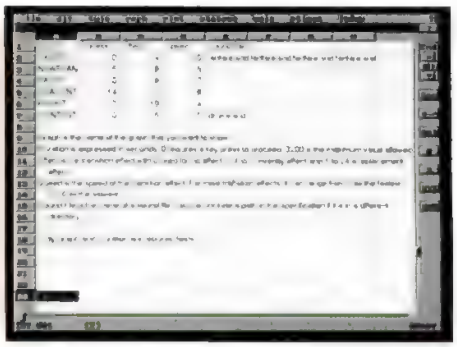
With Borland International's *Quattro Pro*, creating graphs is so easy and there are so many types to choose from that you may not need a separate presentation graphics program. With a little patience and ingenuity, you can use this package to create a slide show for your next meeting.

Building a slide show with *Quattro Pro* is a little more involved than with a standard presentation graphics package. The key to show-making power with this package is the Graph Name Slide menu command. You will have to do some preliminary work, though, before you select this command. To start the process, create and name all of the graphs you want to use, then set up a table in a blank area of the spreadsheet with the information *Quattro Pro* needs for the slide show. You can specify display times and transition effects, and with *Quattro Pro* 3.0 you can even use sound files to awaken any sleepy members of your audience with a trumpet blast to introduce a new topic.

The blank area of the spreadsheet must have at least five blank columns and one row for each slide you have to show. Across the top row, place the following labels: Graph, Duration, Effect, Speed, and Sound File. *Quattro Pro* 3.0 supports all five columns, although only the first two are required.

Record the graph names in the first column, then specify the duration of the graph display in the second column. Enter a display time of 0, and the graph will remain on-screen until you press a key. In column 3, you can choose a transition effect, such as wipe right or barn-door open (the screen clears from the center to the sides). Column 4 is used to control the speed of the transition effect, 0 being the fastest speed and 16 the slowest.

You can use column 5 for an optional sound-file entry. If you want a longer sound presentation, you can list multiple sound files, with the names separated by commas. These files have .SND extensions and are probably installed in your *Quattro Pro* directory; you can specify a path if they are in a different location. You can add new sound files with a Sound Blaster or other board that creates SND files. Once you have completed all your entries and want to begin your slide show, just select Graph Name Slide and specify the table you built. ■



This *Quattro Pro* range will run a slide show that displays six slides. To begin the presentation, you invoke Graph Name Slide and specify the range location, leaving out the top row.

***DoubleDisk, Expanz! Plus, Stacker,* and *SuperStor* compress files as you write them and restore them to original size when needed. Are these utilities the alternative to buying a bigger hard disk?**

Double – No – Triple Your Hard Disk Space With On-the-Fly Data Compression Utilities

by Greg Pastrick

If you use a laptop, portable, or desktop PC configured with a small hard disk, your daily work chores probably include clearing enough space on the disk that you can continue to create new files.

When the obvious alternative of purchasing a larger hard disk is not an option, the solution requires either great discipline or a growing archive of floppy disks. Fortunately, there are a handful of products specifically designed to create new disk space where none existed before; the key to this solution is compression.

Compression works in different ways, but the two functions most applicable to general daily use are batch compression

PHOTOGRAPHY: THOM O'CONNOR

and on-the-fly compression; batch archiving is the most familiar and the most used method. Generally, command-driven utilities convert one or more files to a single compressed file, and they include well-known utilities such as *ARC Plus*, *LHA*, and *PKZIP* ("Squeeze Play," *PC Magazine*, October 15, 1991).

On-the-fly compression utilities (also known as real-time compression products) work in the background, shrinking and expanding files as they are accessed in a way that is totally transparent to the user, and more importantly, to DOS. They use hardware or software, or both, to make entire drives or portions of drives compressed environments. In the process, they give the appearance of doubling the size of available space on a variety of fixed and removable media.

Real-time compression is the focus of the following evaluations. The products included are Vertisoft Systems' $99.95 *DoubleDisk*, Version 2.5, InfoChip Systems' $149 *Expanz! Plus*, Stac Electronics' $149 *Stacker*, Version 2.0, and its $249 Stacker AT/16 coprocessor, and AddStor's $139 *SuperStor*, Version 1.3.

For all of their unique characteristics, the most remarkable detail about this specialized group of products is the similarity of features and functionality across the board. As you'll see, in many ways they perform exactly like the hard disks they enhance and emulate. They all require device drivers, provide the same compatibility with popular software, and use essentially the same technology. Like hard disks, these on-the-fly compression products do what they do with varying degrees of speed and efficiency, but they all do it within the laws and limits of DOS.

GLOSSARY: On-the-Fly Data Compression

algorithm A series of mathematical instructions detailing a solution to a problem.

cluster A storage unit on a disk drive that is comprised of several 512-byte sectors; the number of sectors in a cluster varies from one disk drive to another. A cluster is the minimum amount of space that DOS will use to read and write a file. Higher compression ratios are generally achieved when compression/decompression software uses clusters greater than 4K.

compression ratio Comparison of file size before and after compression takes place. A file reduced from 100 bytes to 50 bytes would be said to have undergone a 2:1 compression. As a general rule, the more redundant the data is, the more it can be compressed. Graphics and database files compress best.

empel-Ziv A compression algorithm, published in 1977, that searches data for repetitive, variable-length byte strings and converts them to smaller fixed-length tokens representative of the entire contents. These tokens are used to restore the data to its original string of characters.

lossless compression A method of file-size reduction that employs a compression algorithm (like Lempel-Ziv) to ensure that data is not changed or lost in the process. Decompression produces an exact replica of the original file.

lossy compression A method of reducing file size that uses a compression algorithm to eliminate or discard information specified as superfluous content in decompressed form. Lossy compression is often used for shrinking audio or image files in which absolute data accuracy is not required, based on the assumption that the loss of data will not be perceived.

on-the-fly compression/decompression The continuous, real-time process of reducing file sizes and restoring data to its original state during read and write requests to a system's hard disk. It occurs in the background of normal computer operations in a way that is transparent to users. Real-time compression/decompression may be achieved by software or by interaction with an add-in coprocessor board. By contrast, archiving software shrinks and restores selected files through users' manual execution of commands.

partition The physical division of the maximum amount of disk space determined by the limits of DOS, which may be assigned to a drive letter. For DOS 3.3 the partition limit is 32MB, while DOS 5.0's limit is 256MB. A single disk may have several partitions, so a 40MB drive could have one 10MB partition and two 15MB partitions.

sector A disk drive's smallest storage unit, typically fixed in size at 512 bytes. ■

THE SCIENCE OF COMPRESSION

Shrinking and expanding the contents of entire hard disks at nearly normal access speeds demand a sophisticated piece of programming. All of the products we reviewed owe their talents to two Israeli professors, Abraham Lempel and Jacob Ziv. The compression algorithm these two men published in 1977 is now known as the Lempel-Ziv algorithm, and it's the genesis of each of these on-the-fly solutions.

All of these utilities also use the *lossless* data compression technique. Lossless technology preserves the integrity of each and every bit of information when it is reduced and restores the information to its original state. Without lossless compression, there would be no point in even considering loading one of these products onto your system.

Algorithms based on Lempel-Ziv compression search a file for redundant character strings, find matches, and convert the strings to small tokens. When the compressed file is needed, the process is reversed. The use of some reference is required to restore each token to its original character string.

For the most part, when developers say they have a proprietary algorithm, it means that they have adapted the technology of Lempel-Ziv's compression algorithm in a unique way and have incorporated it into either a coprocessing chip architecture or software.

Chip-based compression schemes are by far the more sophisticated of the two implementations, and their application in portables and graphics boards is something to look forward to.

Applications incorporating *lossy* compression technology based on Joint Photographic Experts Group (JPEG), Motion Picture Experts Group (MPEG), and now

File Edit Worksheet

(C0) [W12]

A:E10 @SUM(B

	A	B
9		
10	Revenues	$1,260,000
11	Costs	$850,000
12	Profit	$410,000

Market Share

45.0%

30.0%

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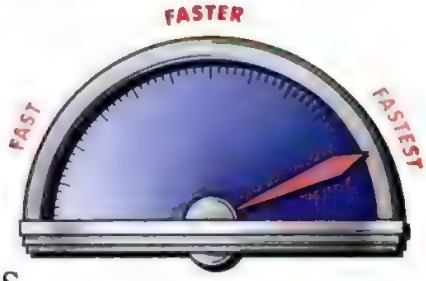

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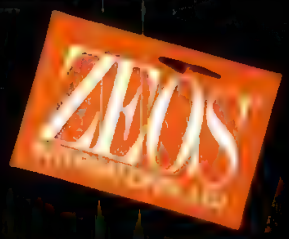

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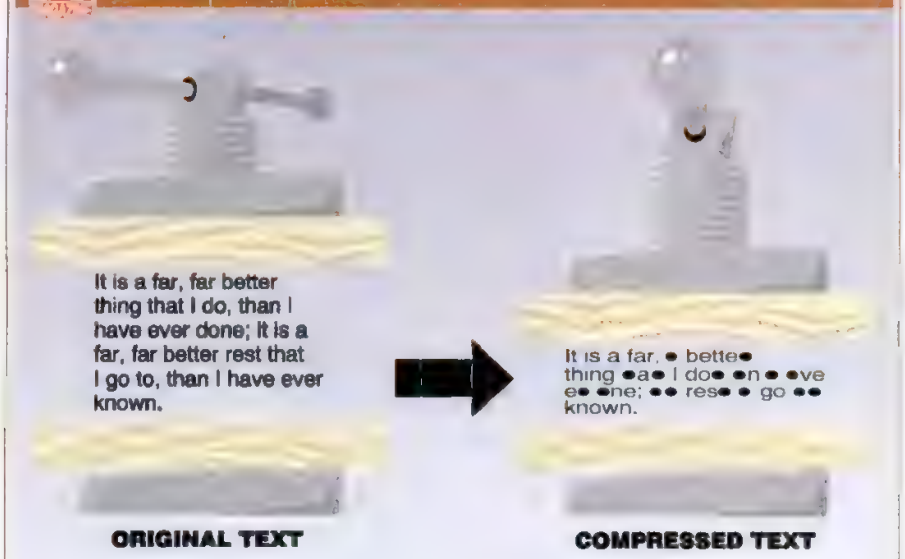
HOW ON-THE-FLY DATA COMPRESSION SQUEEZES TEXT



On-the-fly data compression programs compress text by looking for redundant data strings with at least two characters, which they then convert into shorter, encoded *tokens*. These tokens reference the original string's location and the length of the encoded data.

In the compressed text depicted here, each symbol represents a token that has converted a string of text into a two-number reference point. The first token in this example (which replaces *far*) and the space after it would be *4-5*, indicating that the program counts back five spaces to find the four-character string. The next token, representing *r* and the space after it, would be *2-7*, indicating that the program counts back seven spaces to find the two-character string. Later in the text, a much larger string of 23 characters is represented by the token before *res*. It contains the string "t is a far, far better," which appeared earlier in the quotation.

Text can normally be compressed at least 2:1, and repetitive text, such as the quotation shown here, compresses even better. Data that is still more repetitive, like database files and graphics files (which can contain thousands of identically shaded pixels), compresses best of all, sometimes better than 8:1.

Fractal Image Format (FIF) are widely used in high-end graphics. The difference is that with lossy compression, the algorithms throw out data determined to be visually superfluous, a strategy that yields good compression results and usually doesn't adversely affect the visual quality of an image. That's because graphics images are full of redundant information specifying pixel colors, while other file types contain a larger number of unique bits of data.

No matter how central they are, however, compression algorithms are only one element of the process.

HOW DO THEY DO IT?

How do compression products create more disk space on a piece of hardware that has real physical limits? The answer is found in the interaction between compression algorithms and some loopholes in the law of DOS. In one sense, software programmers rely on DOS's rigid adherence to its own rules to fool the operating system into giving up something it doesn't really recognize it has.

To understand this you need to understand something about the physical layout of files and hard disks. When any medium is formatted, it's prepared to accept information in a way that DOS can logically use, and that's in fixed-length chunks called sectors and clusters. Sector sizes are fixed by the format in multiples of 512 bytes. The formatting process also groups sectors into clusters. Each cluster holds a fixed number of sectors, and this becomes the basic storage unit on a disk. The size of the disk determines the number of clusters it holds, and this rigid system leaves a lot of wasted space.

Although a disk stores data in fixed-length spaces, files come to it as variable-byte-length pieces of information. Let's say a hard disk is formatted in clusters of four 512-byte sectors. This means each cluster holds 2,048 bytes. In this format a 12,536-byte file, about the size of a 2,100-word document, would occupy six full clusters and 248 bytes of next available cluster when saved to disk. That leaves 1,800 bytes of one cluster unused and lost as storage space forever, since DOS saves files at the start of an unoccupied cluster, not at the end of a partially used one.

In other words, DOS blindly ignores hundreds of thousands of bytes of free disk space that compression products use without trouble.

There's more to the magic. Real-time compression hardware and software use device drivers to replace the hard disk interface or to tell DOS that another disk has been attached to the system. As long as the driver behaves according to the rules of DOS devices, the operating system allows data to be freely read from and written to the device. In reality, the device may be a file, partition, or virtual drive, but if DOS recognizes it as a normal disk, the device can do as it likes within the boundaries of its own defined space—which gets to the heart of the secret of data compression.

Each of the products reviewed here manipulates unused disk space in similar yet idiosyncratic ways. In effect, *DoubleDisk*, *Expanz! Plus*, *Stacker*, and *SuperStor* all apply their own formats to device spaces they create on installation. Read and write requests to the device driver for each product are handled like any normal DOS transaction. But within each device space, information is compressed or decompressed according to the architecture of the algorithm. That architecture may reside in hardware on a coprocessor card, as in *Expanz! Plus* and Stacker AT/16, or it may reside in software, as in *DoubleDisk*, *Stacker*, and *SuperStor*.

Some algorithms are more efficient than others, which accounts for differences in compression rates. Variations in performance are a function of how the device driver interacts with the system's processer and speed, how the information is stored on the compressed disk, and how efficiently the hardware or software compresses and decompresses the data. In the end, it's all transparent to DOS and to you.

PERFORMANCE DIFFERENCES

PC Magazine Labs' performance tests show a wide gap in compression/decompression speeds between the fastest and slowest products, and even more of a difference between the best and the worst average compression ratios. One interesting conclusion: Both Stac Electronics products are equally strong on speed and compression. What's more, there's some indication that the Stacker AT/16 coprocessor shows the greatest performance benefit when dealing with large files.

It's also obvious from the performance times that *SuperStor* is optimized for speed over compression. On the other hand, *Expanz! Plus* is optimized for neither, and its 8-bit coprocessor card appears to be the source of its troubles.

All of these products more than double the effective capacity of disks where they're installed. When we averaged the effect of compression across the data types we tested (graphics, database, spreadsheet, executable programs, and text), *Expanz! Plus* was the only program that didn't provide compression better than 3:1. *Expanz! Plus* merely doubled capacity, at 2.1:1. At the other extreme, the best performer, Stacker AT/16, nearly quadrupled the capacity, at 3.85:1.

On-the-fly data compression utilities are essentially load 'em and leave 'em alone products.

COMPATIBILITY PROBLEMS SOLVED

Not too many versions ago some of these products had serious compatibility problems; rest assured, because that is not the case any more. This is safe, proven technology, and the coexistence of each product with DOS depends on the utility acting exactly like any other disk.

We tested each product with *FoxPro*, Microsoft Windows 3.0, *The Norton Utilities*, *PKZIP* and a variety of applications and found no compatibility problems other than disk caches, disk defragmenters, and sector editors. But for them to be fully compatible with a variety of DOS versions, Microsoft Windows, and just about any memory manager, cache software, or disk utility package you can buy (in fact, *SuperStor* is built into Digital Research's DR DOS 6.0), there are some caveats.

It is not recommended to use a disk optimizer or defragger on disks compressed with these programs, except for their own native program, as in the case of *DoubleDisk*. Although these products claim compatibility with either *The Norton Utilities* or Central Point Software's *PC Tools*, it's not a good idea to change bytes at the sector level. You can look, but don't touch.

It is equally wise to use the software's own unerase utility rather than a separate one. If one comes with the package, it's there for a reason. As for Windows, these utilities recommend that if you use a permanent swap file, place it in an uncompressed portion of the disk.

All in all, there's not much to worry about; data compression utilities are essentially load-'em-and-leave-'em-alone products. We experienced no data loss or disk format problems in conducting our tests. But if you have doubts, the best option, as always, is to back up your data before you install the product.

As a group, these compression products are a highly affordable, safe and simple alternative to upgrading your hard disk. They are particularly useful for notebook-size and portable computers. While it's true that their raw performance is slower than unenhanced hard disks, the programs give you twice the hard disk space you originally bought for a lot less money.

EDITORS' CHOICE

■ *Stacker*

The on-the-fly data compression efficiency of the $149 *Stacker*, Version 2.0, sets the standard in this product category. Interestingly, PC Magazine Labs' test results show just a small performance benefit when you add the Stacker AT/16 coprocessor board to the *Stacker* software (for a total of $249). According to our tests, the biggest benefit gained from the AT/16 is the speed of decompression. On compression speed, both products are evenly matched, while on overall compression of our test files, there is about a 1 percent difference between the two. The conclusion: Don't feel compelled to buy the hardware component.

We were so surprised by those numbers that we tried the *Stacker* combination on a standard 286-based system. We expected to find superior performance and compression with the coprocessor card installed, but again we found the software alone to be evenly matched with the performance of the board.

As a second choice, look at AddStor's *SuperStor*. It's optimized for speed and delivers compression and decompression times as fast as *Stacker*'s on our tests while offering fairly good compression ratios.

Regardless of your product choice, it will be a fraction of the cost of a hard disk upgrade.

DOUBLEDISK

Vertisoft Systems' $99.95 *DoubleDisk*, Version 2.5, a real-time compression/decompression program, is one of those products that isn't impressive due to exceptional functionality, inspired technology, or a slick interface; it simply does what it promises to do.

The documentation explains what the program does best: storing files that have the greatest compressibility and don't require frequent instant access. *DoubleDisk*'s approach of building from free disk space extends the hard disk's virtual capacity by creating hidden files that represent multiple disk drives (or partitions) that hold the compressed data.

In action, *DoubleDisk* creates extended drives based on its assessment of existing logical drives on the system. In its own language, logical DOS drives or partitions are known as the host drive, and the program prompts the user in steps to enter values for the actual amount of disk space allocated to the extended drive as well as its virtual capacity. Once the extended drive is established, its virtual capacity is

***DoubleDisk*'s maintenance shell works with a selection of command line utilities to optimize and update compressed disk space. Here, the extend feature from DDUTIL is used to double the virtual capacity of the created disk built from the host drive.**

double that of the actual space it occupies.

This method of disk expansion allows for the creation of up to ten extended multiple-size drives. In this way, an entire disk can be extended, or a series of extended drives can be established to hold different file types—preferably the ones that *DoubleDisk* compresses best. Though the program performs its basic task of increasing apparent disk space, in addition to reducing and restoring files in real time, it lacks some of the performance and features that could make it stand out.

For example, creating, expanding, or verifying the contents of expanded disks requires a good amount of rebooting and deactivating the extended drives. This is especially apparent when growing or shrinking expanded disk sizes based on the amount of available space on the host drive.

SOME MISSING FEATURES

One of the trade-offs for *DoubleDisk*'s low price is the absence of some standard features found in the other hardware and software products reviewed here. Most notable is the lack of a built-in optimization for preparing a drive prior to installation, though the package does come with a utility for optimizing compressed space and offers Golden Bow Systems' *Vopt* for $39.95. On the other hand, there's no support for creating compressed disk space on floppy disk drives. It's important to note that Version 2.5 is not compatible with earlier versions of the program, so if you come back to *DoubleDisk* as an upgrade all previous program files need to be deleted.

Blessed neither with the speed of *SuperStor* or the efficiency of *Stacker*, *DoubleDisk*'s best feature is its $99.95 price tag. *DoubleDisk*'s compression test results are nearly even with *SuperStor*'s. Meanwhile, its decompression speeds routinely beat those recorded by *Stacker*. *DoubleDisk* shows the best on-the-fly compression for bitmapped graphics files of all the products tested. Furthermore, the program clearly outperforms *Expanz! Plus* on all of our tests, though its overall compression is 16 percent less than *Stacker*'s on our mixed format test files.

As the lowest-cost alternative to buying a larger disk, *DoubleDisk* cannot be ignored. If you use large graphics files only occasionally, this may be your best bet. However, if optimal speed and compression ratios for all types of files are required, there are better options.

***DoubleDisk*, Version 2.5**
Vertisoft Systems Inc., Route 5, Box 63, Easley, SC 29640, 800-548-8115
List Price: $99.95
Requires: 512K RAM, DOS 2.0 or later
In Short: *DoubleDisk*, Version 2.5, performs its primary mission of creating expanded disk space and compressing files in the background. It's not the program for optimal speed or compression ratios, but on selected data and graphics files it does perform well. Its low price is its best draw

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EXPANZ! PLUS

By all appearances, InfoChip Systems' *Expanz! Plus* should be a much more efficient and effective real-time compression product than our testing proves it to be. The $149 data compression card has the look and feel of a product that should give the likes of *Stacker*, Version 2.0, a challenge worthy of its shared retail price. By the numbers, its speed in compressing and decompressing files and its compression ratios for various types of data files present another reality.

The *Expanz!* coprocessor card boosts disk space by converting whole partitions and drives to compressible disks. The software and algorithm it employs work together not only to compress files but also to manage the placement of files on the hard disk in the fewest number of sectors possible.

It accomplishes this task through a somewhat lengthy two-part installation process that first installs the software on the hard disk and then creates two backup safety disks. The first of these safety disks is simply a boot disk with the InfoChip driver to gain access to the compressed drives. The other contains the basic software and utilities to manage the compression. Thus, the software provided with *Expanz!* is considered simply a spare tire once the installation takes place.

The second part of the installation requires powering down the system and inserting the coprocessor card. *Expanz!* requires an unoccupied memory address window for the 16K buffer needed by the coprocessor card. Chances are, if you have a 16-bit video card occupying the same memory address space *Expanz!* wants, you'll have to disable the 16-bit video RAM and drop it down to 8-bit mode, as we did in order to proceed with the installation on our test system.

The next step is to use the program's conversion utility to format a compressed drive and its contents. It's essentially a one-time operation, but even the documentation warns that a full partition may take a while to convert. The conversion of our test drive holding 1,000 files of mixed formats took approximately 8 minutes.

To complete the installation, the program automatically initializes the card and adds the InfoChip device driver statement to the CONFIG.SYS file. *Expanz!*

***Expanz! Plus* comes with a selection of diagnostic utilities to size up the amount of available disk space and with statistics on compression ratios for individual files, directories, or compressed drives. For example, IDISK reports the absolute limit that the compressed disk can store if maximum compression (3:1 by default) is achieved on stored files.**

recognizes the presence of expanded memory and loads the driver buffers there if it is available. The 32K device driver may also be loaded into high memory, but its location has little to do with performance.

8-BIT OPERATION

Whatever performance beating *Expanz!* takes in comparison with the Stacker AT/16 coprocessor, or any other product reviewed here for that matter, might be explained as a function of its 8-bit operation. Significantly, on PC Magazine Labs' DOS Variable File Access test, *Expanz!* was the absolute slowest in our measure of on-the-fly file compression/decompression speed.

Compression of the test data is another detail altogether. *Expanz!* turns in a combined average compression on the contents of our seven test subdirectories that is 55 percent less than that achieved by Stac Electronics' coprocessor. Similarly, the same overall compression figure is 30 percent less than *SuperStor*—its closest competition.

If there's anything to be said in favor of *Expanz!*, it's that the coprocessor seems to work particularly well with Microsoft Windows 3.0. Informal PC Labs testing on read and writes to the compressed drive running database routines with the Windows-based *Superbase 4* show a high performance spike that wasn't seen in the results of the other products reviewed here.

In terms of features and compatibility, InfoChip's data compression product is fairly matched to the competition. Like the others, *Expanz!* comes with a package of utilities for diagnosing and reporting the compressed drives' status, creating and removing compressed drives, and optimizing compressed disk space.

Similarly, *Expanz!* supports a list of popular memory management, caching, and disk utility software packages. It even comes bundled with *Super PC-Kwik*.

Expanz! Plus fully lives up to its guarantee to double the virtual capacity of fixed and removable media. The only problem is that InfoChip Systems' coprocessor does not match the level of performance or speed its competition exhibits in the same testing environment.

Expanz! Plus
InfoChip Systems Inc., 2840 San Tomas Expressway, Santa Clara, CA 95051; 800-447-0200, 408-727-0514.
List Price: $149.
Requires: 512K RAM, one 8-bit expansion slot, DOS 3.1 or later.
In Short: The *Expanz! Plus* compression solution is hobbled by an 8-bit coprocessor card that doesn't provide the compression advantage it should, and it doesn't have the performance speed you would expect from a product containing such quality features. While it does increase disk space, it does not come close to matching the speed and compression rates of the competition.

CIRCLE 400 ON READER SERVICE CARD

STACKER
STACKER AT/16

As standalone software or bundled with its line of coprocessor cards, *Stacker*, Version 2.0, sets the standard other real-time compression products have to match. It dominated the other products in its level of file compression, losing in only one of seven categories (.BMP graphics files). And it was best across the board in the speed at which it compressed files and opened those files, on the fly.

Stacker fully lives up to the claim of doubling the available disk space on a selection of drive types, including removable media. Not surprisingly, Stac Electronics is no newcomer to the business of file compression applications. The company has been around since 1983 and sells its controller, coprocessor, and software technology to a long list of processor, tape drive, and utility vendors.

The latest version of the *Stacker* hardware and software represents a major upgrade and enhancement of the company's end-user product line. This is good news, since the first version of the software had fewer features, and its 8-bit coprocessor imposed an inherent performance cap on compression speed. A $49 upgrade fee for registered users will take care of the software deficiencies, but only a leap to the new processor card will bring the highest compression ratios.

We looked at Stac's $149 *Stacker* software package and the $249 package including the Stacker AT/16 coprocessor. Stac continues to offer the $199 8-bit XT/8 card and makes the $299 MC/16 coprocessor board for MCA systems available.

SOFTWARE RUNS THE SHOW

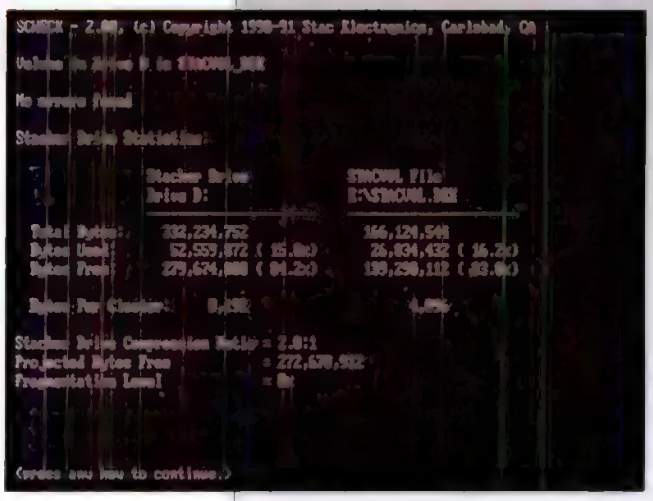
With or without the coprocessor, the *Stacker* software is the key element to initializing and maintaining the compressed drive. Installation of the program is automatic and nearly as transparent as the real-time compression it achieves. The options screens present you with informed choices at all points in the process, as well as summaries of the selections you make. For example, if you choose to create an empty compressed drive rather than compress an existing drive and its data, the next screen displays complete information on the disk and a recommendation

on how many megabytes to devote to the compressed drive, too.

Similarly, the software recognizes the presence of the coprocessor card (if installed) and automatically assigns an open address space for it to occupy. Advanced options are available to fine-tune the compressed drive to increase the compression ratio if the data kept in it falls under the category of being highly compressible, such as TIFF or database files. The amount of uncompressed space to be maintained may also be determined here, if an existing drive is being compressed.

Either way, some amount of uncompressed space on the disk needs to be reserved for essential files such as the *Stacker* device driver and files as well as other DOS files and drivers required for booting the system. Another function of the installation is updating AUTOEXEC.BAT and CONFIG.SYS files as well as copying the group of *Stacker* utilities to a subdirectory.

The set of utilities for creating, expanding, or removing *Stacker* drives may be used directly from the command line or launched from the Stac shell called The Command Assistant. *Stacker* employs a stripped down version of *The Norton Utilities*' SpeedDisk to prep a drive for compression on installation and includes a defragmentation utility that can also be used to grow and shrink compressed drive space. Two additional utilities provide detailed assessments on compressed file sizes, ratios, and disk space. Typical of most other compression utilities, the program complements standard DOS commands and disk utilities and performs special functions. For example, defragmenting a *Stacker* drive with any other utility would destroy the data contained in that drive, yet all normal DOS operations such as running CHKDSK, directory listings, and copying and deleting files work as on any drive.



Stacker's SCHECK provides two views of the same drive information. On the left is a DOS-eye view of the data, and on the right is *Stacker*'s read on the same data in its compressed form. The *Stacker* file is interpreted by DOS as another drive.

ON-THE-FLY DATA COMPRESSION UTILITIES: SUMMARY OF FEATURES

Products listed in alphabetical order

	DoubleDisk	Expanz! Plus	Stacker	SuperStor
List price	$99.95	$149.00	$149.00	$139.00
GENERAL FEATURES				
Compression algorithm	Lempel-Ziv	Proprietary	Stacker LZS	Lempel-Ziv
Size of device driver	42K	32K	41K	46K
EMS support	■	■	■	■
Includes defragger and optimization utilities	■	■	■	■
Includes diagnostic and management utilities	■	■	■	■
Repartitions during installation	■	❑	❑	❑
Has bootable partition	❑	■	❑	■
Maximum number of compressed drives per device	10	Unlimited	10	8
HARDWARE				
Coprocessor board included	❑	■	❑	❑
8-bit card available	❑	■	■	❑
16-bit card available	❑	❑	■	❑
Micro Channel card available	❑	■	■	❑
COMPATIBILITY				
Microsoft Windows 3.0	■	■	■	■
The Norton Utilities	■	■	■	■
PC Tools	■	■	■	■
Super PC-Kwik	■	■	■	■
MEDIA SUPPORTED				
Bernoulli Boxes	■	■	■	■
Floppy disks	❑	■	■	■
SCSI hard disks	■	■	■	■
RLL hard disks	■	■	■	■
RAM disks	■	■	■	■

Editors' Choice ■ Yes ❑ No

UNIQUE BEHAVIOR

Compressed *Stacker* drives don't behave like any drive, though; you'll see unexpected statistics when running DOS DIR. We tested the *Stacker* software and hardware independently on a drive holding two 150MB partitions. We set up the second partition (D: drive) as the host drive to be compressed and loaded it with 1,000 files of mixed formats and sizes. When *Stacker* compresses an existing drive, it creates a hidden DOS file holding all of the data on the compressed drive, reserves 1MB of uncompressed space on the next available drive letter, and places the *Stacker* file in that drive. A device statement, which automatically swaps drive letters so that all data remains referenced to the original drive letter, is entered in the CONFIG.SYS, too. In this way the compressed drive appears to DOS as a drive nearly twice its original size containing uncompressed file sizes.

The results of our speed tests show that there's little difference between *Stacker*'s hardware and software when compressing files, regardless of file size.

On the other hand, the Stacker AT/16 coprocessor shows a marked performance edge in file decompression times; it's the fastest method by far for opening compressed files.

In overall compression ratios (the dif-

PERFORMANCE TESTS: ON-THE-FLY DATA COMPRESSION UTILITIES

PC LABS

Surprisingly, data compression does not always add time to disk operations. Four out of the five products tested can read compressed files faster than files without compression, and the process of compressing and writing files composed of small records to disk is usually faster than writing the same uncompressed files to disk. That's because the change in file size happens in RAM, which reduces the amount of work that a hard disk must perform.

Several products turned in strikingly similar performance in terms of speed, but *Stacker,* Version 2.0, and its hardware companion Stacker AT/16 offered the best compression ratios across a wide range of file types.

WHAT THE NUMBERS MEAN

These four charts show compression and decompression speeds for both small and large records, indicating the number of seconds it took each program to perform the disk access test; the timings, which range from about 3 to 144 seconds, represent the sum of random and sequential reads and writes.

There are two charts for each of the tasks (reading including decompression and writing including decompression): One task created files using small, 200-byte file records, and the other created files with larger, 2,048-byte records.

Products displayed toward the bottom of the charts are faster performers, and the upward slope of the lines shows how compression and decompression slow down as file sizes increase. The shaded area on the chart represents the baseline performance of the same PC tested without a compression utility installed.

In compression, *Stacker,* the Stacker AT-16 (a hardware/software combination), and *SuperStor* were the fastest performers, and the *Stacker* products produced the best compression ratios. *DoubleDisk*'s relatively slow compression times can be attributed to a data integrity feature that verifies every disk write.

The Stacker AT-16's decompression speed was helped by its 16-bit coprocessor, while the software-only utilities *DoubleDisk, Stacker,* and *SuperStor* performed almost identically.

You can see that very often the compression utilities actually enhance hard disk performance. By reading compressed data from the disk into memory (where the decompression actually happens), less disk access is required. On machines with slower processors, this effect is lessened.

The relatively poor speed performance of *Expanz! Plus* on our 25-MHz 386 machine can be attributed to both its 8-bit coprocessor design and its optimization for machines with slower processors that can't afford to handle a compression/decompression algorithm. According to InfoChip Systems, *Expanz! Plus* is primarily targeted at XTs and ATs running at 12 MHz and slower.

The table of file compression ratios shows that the *Stacker* AT/16 software/hardware combination was most effective at compressing six of the seven file types we tried. Note, however, that the *Stacker* software by itself generally came in second, and the compression differences are so small that the additional $100 for the coprocessor board doesn't seem worthwhile.

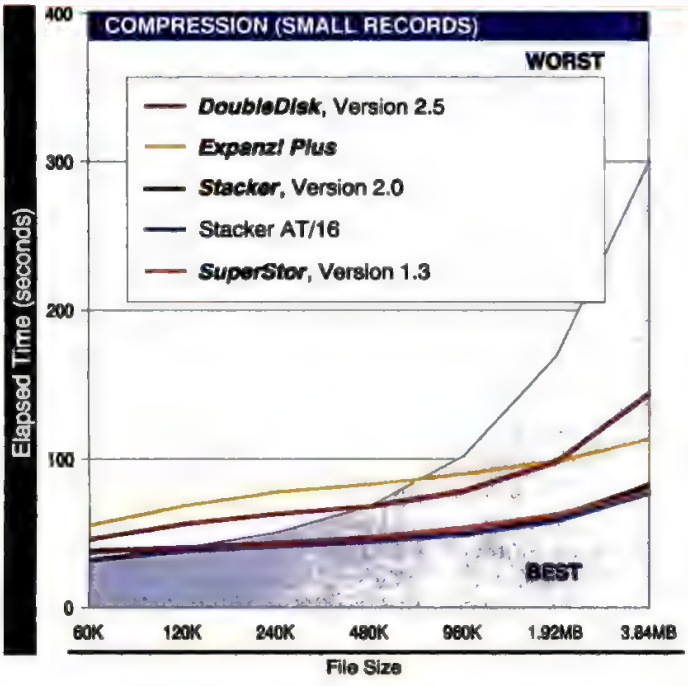
HOW WE TESTED

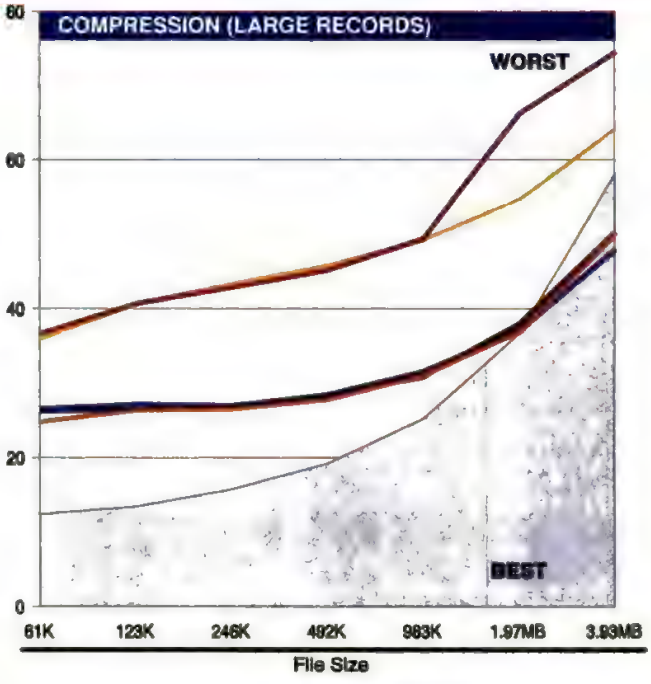
We tested the compression utilities on a Compaq Deskpro 386/25 configured with 8MB RAM, a 16-millisecond 300MB ESDI hard disk partitioned as two 150MB drives, and DOS 4.01. The first disk partition contained DOS and *The Norton Utilities,* which we used to check data and disk integrity, and the second partition held numerous directories filled with various file types and sizes. In all cases, we loaded the compression utilities using their default configuration settings. No software disk caches were used during testing.

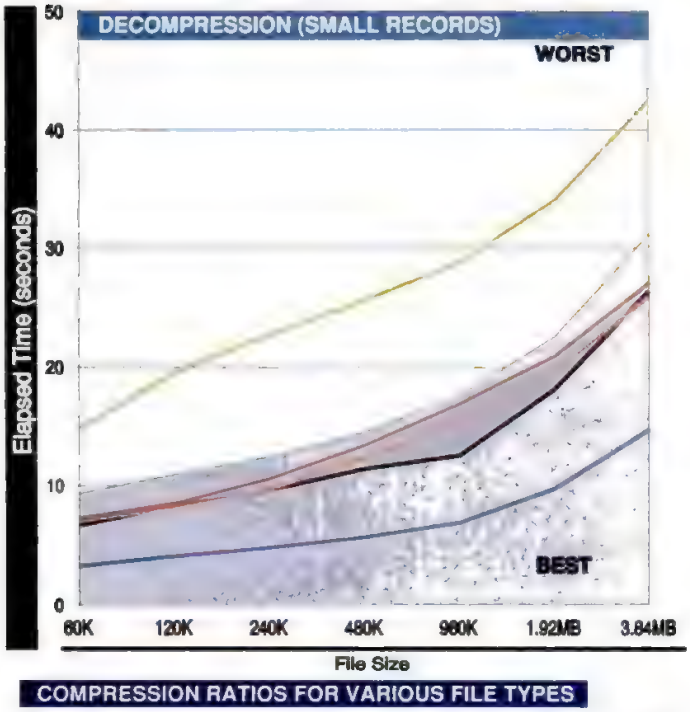
To determine the speed of compression and decompression, we ran PC Magazine Labs' DOS Variable File Access benchmark test for small and large records. The results show how much time it takes to write compressed files to disk and read those files while decompressing them. The times charted on the facing page represent the sum of sequential and random reads and writes.

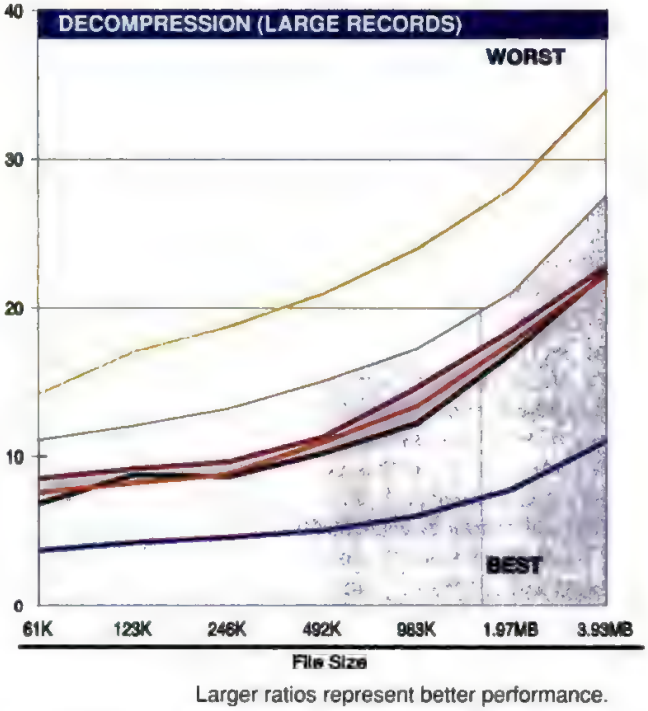
Compression and decompression performance is represented by the time it takes to do a series of reads and writes of 200 bytes and 2,048 bytes on file sizes ranging from 60K to 3.93MB. The four accompanying charts break down performance into compression and decompression of small and large records, and each chart also includes the results from the same machine tested without any compression utility installed.

To evaluate the space savings provided by these utilities, we recorded the sizes of directories holding a selection of executable, database, graphics, worksheet, and text files. We then used each product's drive analysis and status utilities to report the file-by-file and drive compression ratios as the directories were being compressed. The chart shows the average compression ratio for each file type.









COMPRESSION RATIOS FOR VARIOUS FILE TYPES

Larger ratios represent better performance.

	.BMP files	.COM files	.DBF files	.EXE files	.WK1 files	.TXT files	.TIFF files
Stacker AT/16	5.9:1	1.9:1	8.3:1	1.6:1	2.9:1	2.9:1	3.5:1
Stacker, Version 2.0	5.5:1	1.8:1	8.3:1	1.5:1	2.7:1	2.8:1	3.2:1
SuperStor, Version 1.3	3.7:1	1.7:1	7.7:1	1.4:1	2.6:1	2.6:1	2.2:1
DoubleDisk, Version 2.5	6.2:1	1.4:1	4.6:1	1.3:1	2.5:1	2.3:1	3.3:1
Expanz! Plus	3.5:1	1.3:1	2.1:1	1.2:1	2.1:1	1.9:1	3.0:1

FACT FILE

EDITORS' CHOICE

***Stacker*, Version 2.0**
Stacker AT 16
Stac Electronics, 5993 Avenida Encinas, Carlsbad, CA 92008; 800-522-7822, 619-431-7474.
List Price: *Stacker*, $149; Stacker AT/16 (with *Stacker*, Version 2.0), $249.
Requires: 512K RAM, DOS 3.0 or later; one 16-bit expansion slot is required for Stacker AT.16.
In Short: By any measure, *Stacker*, Version 2.0, and Stacker AT/16 are at the top of the line for on-the-fly data compression and decompression. The *Stacker* software is so good at its job that it's hard to justify spending the extra $100 for the coprocessor. Either way, you get the best performance and compression available.

CIRCLE 401 ON READER SERVICE CARD

ference between the original file and the compressed file), the Stacker AT/16 beats the software version only slightly—but they're both clearly superior to other products. The only category where they lost was in .BMP (bitmapped graphics) compression, to *DoubleDisk*.

At best, the coprocessor has an average 5 percent compression edge over the software on the files we tested. The percentages are much more significant once you go outside of the family, though. The Stacker AT/16's average compression ratio on our test data is 21 percent greater than its closest competition, *DoubleDisk* and *SuperStor*. Meanwhile, the AT/16's coprocessor enjoys a 44 percent average compression advantage over *Expanz! Plus*, the only other product with hardware.

As with all the products reviewed, applications and operating system compatibility is not a problem. And since all the software drivers may be loaded into high memory, TSR overhead is of little consequence. What it comes down to is how much compression you can get on application and data files and how fast you can access data on the compressed drive. On both counts, Stac's software and coprocessor card are the products with the best overall compression and speed.

The real decision comes down to a choice between the Stacker AT/16 card and *Stacker* alone. On this score, the performance benefit gained from the AT/16 is hard to justify unless your hard disk or backup medium is populated with large data files and numerous megabyte-hogging applications. Under those conditions, the extra $100 is worth spending.

SuperStor

One of the big surprises of our testing was how quickly *SuperStor*, Version 1.3, from AddStor, compressed files. *SuperStor*'s writing times virtually match those of *Stacker* (both versions). It didn't do quite as well at reading those compressed files though *SuperStor* outperformed all of the other products except *Stacker*, in its decompression speeds.

SuperStor ($139), was often second-best to *Stacker* on the amount of compression it performed as well. It was weak only in graphics files (both .BMP and TIFF) but strong in database (.DBF), spreadsheet (.WK1), and text files. These statistics were not bad for a product that was about to receive a significant upgrade soon after our performance tests were run.

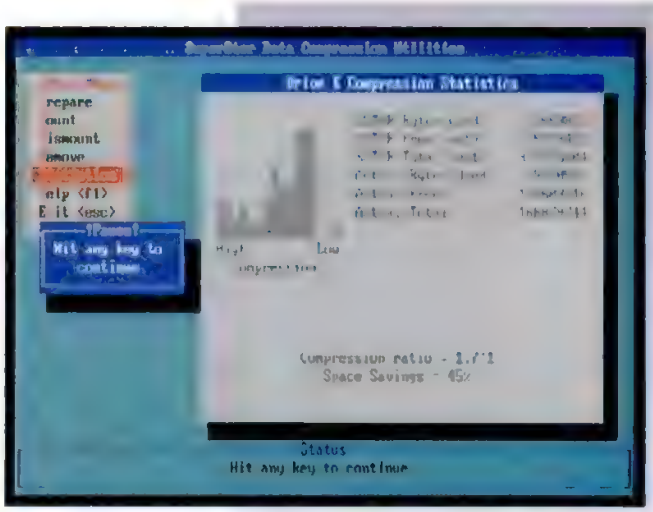
All future revisions aside, for now *SuperStor* offers two main approaches to making more space on fixed media. AddStor's automatic installation steps you through the process of either totally compressing an existing drive or a partition and its contents or creating mountable compressed drives. The second option allows the user to leave some uncompressed disk space free and affords the building of multiple compressed files that are attached to the *SuperStor* device driver as accessible drive letters.

In addition, *SuperStor* has a specific option to create compressed floppy disks. For maintaining the compressed drives, the software comes with a handful of utilities handled through the *SuperStor* shell or directly from the command line.

The interface of the menu shell is clean and direct. It includes programs for creating, removing, mounting, dismounting, expanding, or shrinking compressed drives. Status and statistics on the compressed drives, such as compression ratios and available space, may also be reported from the utilities shell or the command line.

Tests show *SuperStor*'s speed in compressed disk reads and writes to be truly exceptional.

Whether the choice is to convert an existing fixed partition completely or to build one or more mountable files, *SuperStor* requires little or no effort to get the software up and running. Optimal-configuration guidelines for the product from the company involve running the automatic installation and making sure the driver is in the CONFIG.SYS file.



***SuperStor*'s display of compressed disk statistics shows a mix of information. Its report of fixed and mountable disks details the actual number of bytes used by the program's driver to store the data on the compressed disk space. You also get an estimate of free space and an overall rating on compression to indicate the software's efficiency in creating extra space.**

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CODE A1802

CIRCLE 194 ON READER SERVICE CARD

MIXING COMPRESSED SPACES

The true versatility of the program comes through in the mix of compressed spaces you can put on any given partition or drive. The program presents some intriguing possibilities, such as the ability to create a series of compressed files attached as drives devoted to specific applications and file types. Administrators should beware, though, because these opportunities could spell trouble to an overworked hard disk or an unsophisticated user.

Some of the strategies suggested by the documentation for achieving the highest performance require a level of comfort that many users just don't have in tasks such as partitioning and backing up compressed and uncompressed drives. The difficulty can be as little as having to keep track of details such as editing the appropriate maximum number of mountable drives in the CONFIG.SYS.

On the other hand, the difficulty can be as large as having to format drives physically and manipulate device drivers appropriately to create what AddStor calls nonstandard bootable drive configurations. Even the AddStor block driver has to be loaded manually into the high-memory area.

Automating and simplifying some of these functions will do much to increase the appeal of this program. And according to AddStor, the next release of *SuperStor* adds some improvements along these lines. They include automatic recognition and installation of the block driver into high memory and compressed drive conversions that automatically leave uncompressed space. The company also promises two new utilities for optimizing and repairing compressed drives. They will be welcome additions.

EXCEPTIONAL PERFORMANCE

Make no mistake, even in its newborn condition the program runs a strong second to *Stacker*. And our tests show its speed in compressed disk reads and writes as being truly exceptional. With growth, development, and improved compression ratios, *SuperStor* could be real competition for *Stacker*. In its current version, the software is incorporated in DR DOS 6.0 and is being bundled with all Comp USA laptops and notebooks. Its promise is already being recognized. ■

Greg Pastrick is a Massachusetts-based free-lance writer and frequent contributor to PC Magazine.

FACT FILE

***SuperStor*, Version 1.3**
AddStor Inc., 3905 Bohannon Dr., Menlo Park, CA 94025; 415-688-0470.
List Price: $139.
Requires: 512K RAM, DOS 3.2 or later.
In Short: The optimization for speed over compression serves *SuperStor*, Version 1.3, well. Being a software-only solution, it might enjoy the compression benefit of a coprocessor. But on its own, the software yields solid compression ratios at competitive speeds.

CIRCLE 402 ON READER SERVICE CARD

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by
Joe Salemi

Advisor

- FIXING OLD FLOPPIES: If your 3.5-inch disks are missing the write-protect shutter, here's how to write-enable them again.
- LEARNING ASSEMBLY LANGUAGE: Books to help you master assembly language and DOS functions.
- FINDING FONTS: Locating font cartridges for your IBM LaserPrinter.
- SLOWING DOWN A FAST SYSTEM: Running slow software on a speedy PC.
- X RAYS AND LAPTOPS: Is there a chance for data loss?
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FIXING OLD FLOPPIES

Over time I've accumulated more than a few 3.5-inch floppy disks from which the write-protect shutters have been physically removed to insure permanent write protection. The shutters are easy enough to install so I can reuse the disks, but where are they available?

Bill Kraengel, Jr.
Valley Stream, New York

PC MAGAZINE I'm not aware of anyone who sells just the shutters, but there are other ways to solve the problem and recycle those write-protected disks. The most obvious solution is to carefully remove and reuse the shutters from disks that have gone bad and are destined for the trash, but there are some other remedies as well.

Disk drives use an LED (light-emitting diode) to determine if the shutter is open or closed; if the light from the LED gets through to the sensor, the drive knows that the shutter is open and won't write to the disk. Find a way to block the opening, and you can reuse the disks.

For temporary or one-time use, you can block the hole by wrapping a dark piece of tape over the edge of the disk. Black electrical tape is ideal for this, and I've also been successful using the write-protect tapes that come with 5.25-inch floppies. Be careful when inserting and removing the disk, though; the tape could get caught on the edge of the drive's door opening or mechanism, and then you'll probably have to remove the drive from the machine to get the disk or tape out. So do this only if you're going to reuse the disk just once (for archiving purposes, perhaps).

A solution that lets you reuse the disk multiple times is to cover the hole with a thin piece of cardboard (such as the type that comes with dress shirts). Cut out a rectangle of cardboard that's slightly bigger than the hole, so that friction will hold it in place, and insert it into the slot on the disk. Tweezers are a helpful tool for this task. If you don't make the cardboard cover too large, you can probably take it out later on if you want to write-protect the disk again. It may take some experimentation to get it right, but I've heard of a number of folks who have had great success with this method.

LEARNING ASSEMBLY LANGUAGE

I'm interested in learning assembly language. Can you recommend any good books on the subject, and also a good reference on DOS functions?

Robert Wilson
Grants Pass, Oregon

PC MAGAZINE My favorite books for learning assembly language are *Peter Norton's Assembly Language Book for the IBM PC* (Peter Norton and John Socha, $24.95; Brady Books, One Gulf + Western Plaza, New York, NY 10023; ISBN 0-13-662453-7), and *Assembly Language Primer for the IBM PC & XT* (Robert Lafore, $24.95; The Waite Group Inc., New American Library, 1633 Broadway, New York, NY 10019; ISBN 0-452-25497-3). Unfortunately, the latter book is listed as out of print, though you may still be able to find a copy in a computer bookstore.

Both of these books get you started writing assembly language programs using the DEBUG utility that comes with every copy of DOS. When you are ready to go beyond that, you'll need to obtain an assembler (a compiling program that turns your ASCII source code into an executable program).

For a minimum investment, you can get the shareware A86 Assembler directly from the author (Eric Isaacson Software, 416 E. University Ave., Bloomington, IN 47401; 812-339-1811; $50), from various BBSs or shareware distribution companies, or in Library 1/Assemblers on the CompuServe IBMPROG forum as A86.ZIP.

A number of commercial assemblers are also available. For DOS programs, there's the Turbo Debugger and Tools (Borland International Inc., Scotts Valley, CA 95066; 408-438-8400; $149.95). The Macro Assembler (IBM, Armonk, NY 10504; 800-426-2468, 914-765-1900; $189) and MASM (Microsoft Corp., Redmond, WA 98052; 800-426-9400, 206-882-8080; $150) support both DOS and OS/2 programming.

Two good references on the DOS functions are *The Peter Norton Programmer's Guide to the IBM PC and PS/2* (Peter Norton, $22.95; Microsoft Press, Bellevue, WA 98009; ISBN 1-55615-131-4) and *Advanced MS-DOS*, by *PC Magazine* contributing editor Ray Dun-

can ($22.95; Microsoft Press; ISBN 0-914845-77-2).

FINDING FONTS

Your "How They Held Up: Printer Endurance Tests" article (October 15, 1991) mentioned a company, Intercon Associates, that manufactures font cards for the IBM LaserPrinter E. Can you provide the address and telephone number for this company?

Mark W. Curnutte
Vinita, Oklahoma

You can contact Intercon Associates at 1850 Winton Rd., Rochester, NY 14618; 800-422-3880, 716-244-1250. Intercon produces a number of cartridges for the IBM Laser-Printer 4019 and 4019E, including the Bar None ($195), with Letter Gothic and Character Set fonts and bar code support (equivalent to the HP Bar Codes and More cartridge); the BOLD Image ($349), with Helvetica, Times Roman, and Presentation fonts and larger point sizes for headlines; the Gold Card ($229), with over 200 different fonts.

Intercon also makes a number of different cartridges for the HP LaserJet II and III series. Among them are the Perfect Type II ($325) and Perfect Type III ($325), with Swiss, Century, Prestige Elite, and Character Set fonts, and the PRO IIP ($275), with Swiss and Century fonts that range in size from 6 to 30 points, and Prestige Elite, Letter Gothic, and Presentation fonts that range in size from 7 to 18 points.

You can get information on other third-party font cards from your local IBM authorized dealer. To find the dealer nearest you, call 800-IBM-2468 and tell them you're looking for information on IBM's laser printers.

SLOWING DOWN A FAST SYSTEM

Recently, I upgraded from a 286-based PC to a 33-MHz 486. Unfortunately, many of the older games and applications that have their timing tied to the system clock are unplayable. *The Norton Utilities'* SI indexes are 50.1 and 32.1, fast and slow speeds respectively. Even at the slow turbo speed the applications run too fast.

Is there anything that can be done to salvage the cherished games?

Frank Stachow
Brooklyn, New York

This problem goes back to the original fast ATs, and many utility authors have tackled it. The simplest way of slowing down the system is a TSR that does nothing but run empty timing loops, eating up some of the CPU's cycles. In the December 9, 1986, issue, contributing editor Charles Petzold presented the SLOWDOWN utility, which uses a command line to determine the slowdown rate. This utility is available in Library 7/Tutor of the PC MagNet Utilities/Tips Forum as SLOWDO.ARC.

More recent variations of this type of program are available in Library 4/Gen. Hardware of the IBM Hardware Forum on CompuServe (CIS:IBMHW). SLOWDOWN (John Ruzica, 1614 Fell St. #4, San Francisco, CA 94117; $5) is a shareware program from March 1990 that also sets and changes the speed from the command line; the actual filename is SLOW.ZIP.

SLOWPC (Dr. M. Sawada, P.O. Box 956, Outremont, Quebec, Canada H2V 4R8; $10) is designed especially for 486 systems (March 1991). In addition to the command line, SLOWPC has a pop-up menu that lets you adjust the system speed to your liking without having to exit your application. The filename is SLOWPC.ZIP.

Note that all of these utilities work only if the game or application runs from the DOS prompt. If the game boots off its own disk, the only solution is to get an upgrade to a newer version (if possible) from the vendor.

X RAYS AND LAPTOPS

I may have missed it the last time this issue was raised, but what is the current view of the effects of airport X-ray machines on laptop/notebook PCs? I recently bought one and am doing a lot of traveling. I've been asking the attendant to inspect the PC personally, but it's a hassle I'd gladly avoid if there are minimal or no risks involved. Thanks!

Scott Rex
Durham, North Carolina

The general principle that I've read and heard is that the X rays have little or no effect on hard disks and floppies, so there's no danger to your data from them. There is a danger from a different angle, though— being electronic, the X-ray machine may put out a strong magnetic field if it isn't properly maintained, and this can cause havoc with the magnetic field that stores the data on disks (and audio cassette tapes, for that matter).

Another factor to consider is airport security, especially at international airports; unfortunately, there have been incidents of explosive devices being smuggled on planes inside of electronic devices such as radios. Even if a laptop/notebook goes through the X-ray machine, the security personnel may require the owner to open the PC and turn it on, to prove that it functions.

So, in spite of the slight hassle involved, it's probably best to keep your laptop/notebook system (and its floppy disks) in a separate carrying case, and continue to have it hand-inspected by the airport security folks.

COMPUTERIZED INVESTING REVISITED

In response to Dan Bunnell's question about investment software in your June 25, 1991, column, you mentioned a few of the hundreds of analysis, tracking, and service-based programs available today. I would suggest that Mr. Bunnell get a copy of *The Individual Investor's Guide to Computerized Investing*, published by the nonprofit American Association of Individual Investors (625 N. Michigan Ave., Dept. CI, Chicago, IL 60611; 312-280-0170). The book details the specific features of software for compatibles and Macintosh/Apple systems.

Robert L. Cutler
Gold River, California

Thanks for letting us know about this organization. In addition to the guidebook ($19 for members; $24.95 for nonmembers), the AAII publishes a bimonthly newsletter called *Computerized Investing* ($30 per year for members; $60 per year nonmembers). Annual membership dues are $49 per year; for an information packet on the AAII, call or write to the organization's headquarters at the numbers above.

ASK THE ADVISOR

Send your question to PC Advisor, One Park Avenue, New York, NY 10016, MCI mailbox PC MAGAZINE, or upload it to PC MagNet (see the instructions for joining on page 10). We regret that we are unable to acknowledge submissions or answer letters individually. ■

by
Jeff Prosise

Tutor

RAM ARITHMETIC

I recently learned that the 384K region between 640K and 1MB (sometimes called the upper memory area) is reserved for hardware use and that extended memory starts at the 1MB mark, not at 640K.

Does this mean that my 286-based PC with 640K of conventional memory and 384K of extended—1,024K (1MB) altogether—also includes the 384K upper memory area, bringing the total RAM up to 1,408K? Is the same true of all PCs with 1MB of RAM?

Gordon Lee
Los Angeles, California

Not quite. While it's true that your PC's total address space is 1,408K, it's not all populated by RAM. Your machine has 1MB of RAM: 640K conventional, plus 384K extended. It also reserves the 384K region between 640K and 1MB for use by hardware devices such as BIOS chips, network adapters, expanded memory boards, and video controllers. ROM, not RAM, occupies much of this reserved area. Anything left over—on most systems—is simply unused space. What RAM there is generally serves special hardware uses such as storing video data.

If you have a 386 and use a 386 memory manager such as *386MAX*, *QEMM-386*, or EMM386.EXE (the memory manager that comes with DOS 5.0), you can convert some unclaimed regions between 640K and 1MB into pockets of usable RAM called upper memory blocks or UMBs, and load TSRs and device drivers there. While this makes more RAM available to DOS, it doesn't increase the total amount in your system—the extra DOS-accessible memory isn't magically created from nothing. It's "borrowed" from extended memory by programming the 386 chip to translate addresses in upper memory to addresses in extended memory. The result? There's more RAM available to application programs, but still only 1MB in the system.

- **RAM ARITHMETIC:** A megabyte of RAM is still 1MB, no matter how you add it up.
- **SWAPPING TO MEMORY:** Getting the DOS 5.0 Shell to swap tasks out to extended or expanded memory.
- **FINDING FREE DRIVE SPACE:** Here's a utility to help you determine the space remaining on a drive.
- **COMMENTS IN CONFIG.SYS:** How you can annotate your CONFIG.SYS file as though it were a batch file.

SWAPPING TO MEMORY

I use the task swapper built in to DOS 5.0's Shell to switch between several active programs, but I'm frustrated that it saves session-related information to the hard disk. Swapping it out to extended or expanded memory would be much faster, and the 4MB of RAM in my 25-MHz 386 would easily accommodate the data. Is there some way to make the Shell swap programs to memory rather than to the hard disk?

Joe DiMarino
Amherst, Massachusetts

There is a solution, albeit an indirect one. Before swapping a task to disk, the Shell determines the drive and directory it will use by looking at an environment variable called TEMP. If no such variable exists, the Shell copies the data to the current directory; if TEMP does exist, the Shell copies the data to the drive and directory that TEMP names. For example, if your AUTOEXEC.BAT file contained the statement SET TEMP=C:\DOS, the Shell would swap files to the \DOS directory of drive C:.

With this in mind, you can trick DOS into using extended or expanded memory by pointing the TEMP variable to a RAM disk. DOS 5.0's virtual disk driver, RAMDRIVE.SYS creates the RAM disk in extended memory if installed with its /E switch or expanded memory when loaded with /A. For instance, suppose the driver resides in the \DOS directory of drive C:. The line

```
DEVICE=C:\DOS\RAMDRIVE.SYS 1024 /E
```

added to CONFIG.SYS creates a 1MB RAM disk in extended memory. (Note, if your 386 is configured to load TSRs and device drivers high, you could replace DEVICE with DEVICEHIGH and save slightly more than 1K of conventional memory.) Then, if the RAM disk is assigned the drive letter E:, the statement SET TEMP=E:\ completes the process. If you haven't tried this, you'll be delighted at the difference in speed. With a RAM disk as the target for task switching, you can switch between programs almost instantaneously. Furthermore, the larger the RAM disk, the more programs you can juggle without time-consuming hard disk accesses. For two applications, 1MB is generally sufficient. For three or more, you may want to increase the RAM disk's size accordingly—particularly if they are large applications such as *WordPerfect* or *Lotus 1-2-3*.

DOS 5.0 uses the drive and directory specified by TEMP for another purpose also—to store temporary files created when you pipe data from one command to another. Thus, pointing TEMP to a RAM disk speeds up piping by a modest amount.

If you haven't done so already, add a SET command to your AUTOEXEC

.BAT file pointing TEMP to some location on either a hard disk or a RAM disk. Then, if you use a piping operator—even when the current drive is a floppy—DOS will create its temporary files on the faster medium.

FINDING FREE DRIVE SPACE

I'd like to write a batch file to install an application on a hard disk. How can I make it smart enough to abort if there's not enough room on the drive? Is there any way to determine the exact amount of free space left on a disk?

Michael Grijtak
Kettering, Ohio

There certainly is. One way is to use *PC Magazine*'s BATCHMAN utility, which you can download from PC MagNet. BATCHMAN's CANCOPY function determines whether a particular file or set of files will fit on a disk. The following command

```
BATCHMAN CANCOPY *.* C:
```

returns 0 via the DOS ERRORLEVEL if there's enough room on drive C:, 1 if there's not. It even takes the cluster size of the destination disk into account so you won't get any nasty surprises if enough bytes remain free, but there are too few clusters.

Alternatively, you can run the DEBUG script shown in Figure 1 to create MEGSFREE.COM. This utility returns a value—rounded down to the nearest megabyte—indicating the total amount of space remaining on a drive. You can test this value in a batch file with an IF ERRORLEVEL command. For example, the following statements

```
MEGSFREE C:
IF NOT ERRORLEVEL 4 GOTO ABORT
```

would branch to a line labeled ABORT if drive C: contained less than 4MB of free space. If you run the MEGSFREE utility without specifying a drive, it will default to the current drive. So for example, if you knew in advance that drive C: was the default, you could have simplified the first line to read

```
MEGSFREE
```

There's one thing to keep in mind when using MEGSFREE: Since ERRORLEVEL is used to return a value, it can't be used to let you know when an error, such as entering the wrong drive letter, occurs. So enter the drive letters carefully.

The utility works by calling DOS function 36h, which accepts a drive specifier in register DL (where 0=the default drive, 1=A:, 2=B:, and so on) and is accessed through interrupt 21h. On return, AX holds the number of sectors per cluster, BX stores the value for unused clusters on the drive, CX contains the number of bytes per sector (512 for most disks), and DX holds the total quantity of clusters on the disk. (Note: A *cluster*, which is also called an *allocation unit*, is the smallest amount of space DOS will allocate to a file; most hard disks contain either 4 or 8 sectors per cluster.)

To determine the number of bytes free, MEGSFREE multiplies the value in AX by the contents of BX, and the result by the value in register CX. It then converts bytes to megabytes by shifting the product right 20 bits—effectively dividing by 1,048,576. With the final result in AL, the program terminates using DOS function 4Ch, which passes the value back to DOS where it can be tested with the IF ERRORLEVEL command.

Note that MEGSFREE returns 255 for drives with 255MB *or more* of unused space, since AL can hold no larger value. This shouldn't be a limitation for most applications.

MEGSFREE.SCR COMPLETE LISTING

```
A 0100
CLD
MOV  SI,0081
LODSB
CMP  AL,20
JZ   0104
XOR  DL,DL
CMP  AL,0D
JZ   0115
AND  AL,DF
SUB  AL,40
MOV  DL,AL
MOV  AH,36
INT  21
MUL  CX
MUL  BX
MOV  CX,0014
SHR  DX,1
RCR  AX,1
LOOP 0120
CMP  AX,00FF
JBE  012E
MOV  AX,00FF
MOV  AH,4C
INT  21

N MEGSFREE.COM
RCX
32
W
Q
```

Figure 1: Redirecting the script shown above into DEBUG produces MEGSFREE.COM, a utility used to determine the amount of space remaining on a logical drive.

> There's one thing to keep in mind when using MEGSFREE: Since ERRORLEVEL is used to return a value, it can't let you know when an error occurs.

COMMENTS IN CONFIG.SYS

Is there a way to add comments to a CONFIG.SYS file? In batch files, you can use the REM statement, but CONFIG.SYS doesn't seem to support it.

Charlie Blaney
Sherborn, Massachusetts

DOS does support REM statements in CONFIG.SYS in Versions 4.0 and 5.0. In earlier versions, there was no equivalent command. One solution, then, is to upgrade to DOS 5.0. If you're running an earlier version of DOS, and all you want to do is comment out one or two commands, you can use REM anyway. Doing so will cause DOS to output an "Unrecognized command in CONFIG.SYS" error message. The message is harmless, and the command that follows REM on that line is safely ignored.

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. Send your question to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload it to PC MagNet (see page 10 for instructions). We regret that we can't acknowledge submissions or answer questions individually. ■

by
Neil J. Rubenking

User-to-User

KEY CODE VALUES

KEYCODE.COM gives the scan code and ASCII value, in hex and then in decimal, for any non-shift key pressed. It will also echo the key press if it is a printable ASCII character. It's especially useful for redefining keys with ANSI, as it not only provides correct extended ASCII codes, but shows which keys are considered dead by DOS. Or you can use it to quickly provide key code values for use with utilities such as *PC Magazine*'s KEYFAKE.COM. I find it valuable since most reference tables of key codes are incomplete, many giving only hex, or only decimal, or only the lower ASCII values.

KEYCODE uses the lines

```
MOV AH, 00
INT 16
```

to return the scan and ASCII values. For an extended keyboard change the first line to `MOV AH, 10`. To exit from KEYCODE type Ctrl-Break (^C only displays its key values).

KEYCODE.SCR (Figure 1) should be created with an ASCII editor. Be sure to put a carriage return after the final Q. To create the program, enter

```
DEBUG < KEYCODE.SCR
```

at the DOS prompt.

David M. Dibble
Riverside, California

- **KEY CODE VALUES:** This simple program gives you the ASCII and scan codes for any key.
- **BATCH FILE STRING INPUT:** Here's a way to let users input strings into batch files for DOS versions before 3.3.

It's incredibly convenient to be able to check the ASCII and scan codes for any key right at your computer. Suppose you want to set the Ctrl-F1 key to HELP followed by a carriage return, thereby bringing up the list of DOS 5.0 commands that the help system supports. First, run KEYCODE and press Ctrl-F1. You'll see a line like

```
=  5E 00 hex      94   0 decimal
```

The number you want is the decimal scan code, 94. To make an ANSI key assignment using that number, it's easiest to use the PROMPT:

```
PROMPT $e[0;94;"HELP";13p
```

The $e metastring stands for the escape character; combined with a left square bracket it's the beginning of an ANSI command string. 0;94 tells ANSI we're redefining the special key whose extended scan code is 94. We redefine it to "HELP" plus character 13, the carriage return character. The small p at the end tells ANSI the command string is finished. Of course you'll want to restore your normal prompt after entering this command.

KEYCODE.SCR is an unusually long DEBUG script, so I extracted the comments from Mr. Dibble's assembly code and put them into the DEBUG script. While you're in assembler mode, DE-

KEYCODE.SCR — COMPLETE LISTING

```
N KEYCODE.COM
A 100
JMP 0126
DB  " =  "
DB  "      hex      "
DB  "    "
DB  "    decimal",0D,0A,24
MOV AH, 00          ;for extended keyboard, change to MOV AH, 10
INT 16              ;return scan code AH, ascii in AL
MOV BX, AX          ;store in BX.  BX is uneffected by
MOV DL, AL          ;    hexidecimal or decimal routine
MOV AH, 02
INT 21              ;see if ascii printable character
MOV DI, 0106        ;pointer to start of hex template
CALL 0151           ;call hexadecimal routine
MOV AL, BL          ;ascii value in AL
MOV DI, 011A
CALL 0170           ;call decimal routine
MOV AL, BH          ;scan value in AL
MOV DI, 0116
CALL 0170           ;call decimal routine
MOV DX, 0102        ;display all values
MOV AH, 09
INT 21
JMP 0126            ;go again.  Quit with Ctrl-Break
MOV CX, 0404        ;HEXIDECIMAL: counter in CH, rotate value in CL
ROL BX, CL          ;get digit in BL. (Note that 4 rotations
MOV AL, BL          ;     will leave BX unchanged, when done.)
AND AL, 0F          ;zero high bits--do one number at a time
OR AL, 30           ;add 30h, makes display-able ascii value
CMP AL, 3A          ;digit 0-9 if below
JL 0162             ;jump to SHOW
ADD AL, 07          ;else make letter A-F
MOV [DI], AL        ;place with DI pointer
INC DI              ;next position right
CMP CH, 03          ;have we got end of scan code?
JNZ 016B
INC DI              ;  if so, then leave one space
DEC CH              ;decrease counter
JNZ 0154            ;if counter not zero, go again
RET
MOV CX, 030A        ;DECIMAL: counter in CH, divisor in CL
XOR AH, AH          ;zero AH
DIV CL              ;divide AL by 0A (10 d), remainder in AH
OR  AH, 30          ;make AH a display-able ascii value
MOV [DI], AH        ;and place with pointer
DEC DI              ;move one posiiton left
DEC CH              ;decrease counter
JZ 018A             ;if counter zero, jump to return
CMP AL, 00          ;still a numerator to work with?
JNZ 0173            ;  if so, go again
MOV BYTE PTR [DI], 20 ;fill out three digits with blanks
JMP 017C            ;      if necessary, to clear work area
RET

R CX
8B
W
Q
```

Figure 1: The program created by this DEBUG script gives you the ASCII and scan codes for any key you press.

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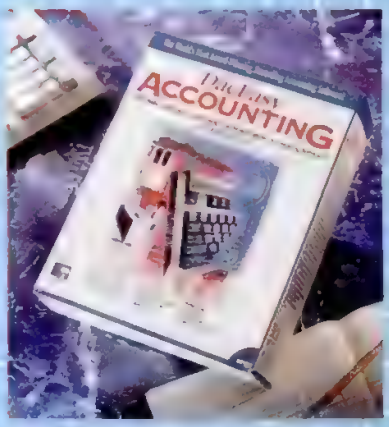

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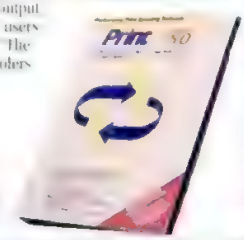

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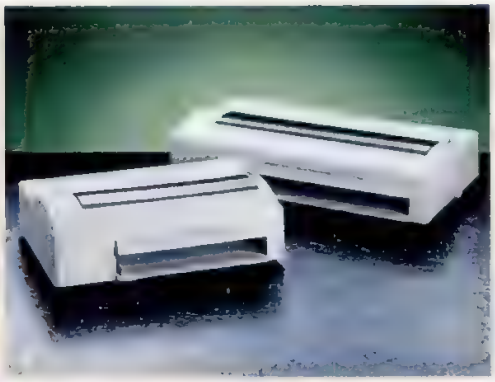

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$29

CIRCLE 225 ON READER SERVICE CARD

BUG will ignore comments beginning with a semicolon, just like an assembler does. If you're typing in the DEBUG script you can omit the comments.

When processing a complex DEBUG script like this one, you need to guard against errors. One way to do that is to first log the progress of the DEBUG session like this:

```
DEBUG < KEYCODE.DBG > KEYCODE.LOG
```

Now either scan the .LOG file with a text browser or give the command

```
FIND /N "^ Error" KEYCODE.LOG
```

If there were any errors, this command will list them along with their line numbers in the LOG file.

BATCH FILE STRING INPUT

Some time ago I was inspired by your Lab Notes column (January 30, 1990), especially by the batch file GETREPLY.BAT. I wanted to write a similar routine to input a string into a batch file for users of DOS versions earlier than 3.3. Finally I created ANSRGET.BAT (Figure 2), which does just that. It uses two .DAT files to help. ANSSETEQ.DAT contains the string `SET ANSWER=` without any carriage return, line-feed, or end-of-file marker. ANSRET.DAT contains `ANSRGET %ANSWER%` and *does* end with a carriage return and line-feed.

ANSRGET.BAT creates another file, ANSSETEQ.BAT, which saves the string input and then reruns ANSRGET.BAT using the value of the environment variable ANSWER as a parameter. If ANSRGET.BAT "sees" a parameter, it loops to a point after the string input was requested.

In the example, ANSSETEQ.BAT is deleted and ANSWER is reset to nothing. However, you could use this method to set environment strings that could be called by other programs or used as reminders or help messages for users.

You may have to enlarge the DOS environment, easily done with the SHELL statement in your CONFIG.SYS file.

Allen A. Adams
Calgary, Alberta, Canada

COMMAND/C and the CALL command both let one batch file call another and then return to the calling batch file.

There are two principal means one batch file can use to call another and then return to the same line in the calling batch file. The first is to start a secondary command processor with COMMAND /C followed by the batch filename. The second, available in DOS 3.3 and later versions, is the CALL command. What's so great about CALL? When you run a second batch file with COMMAND /C, any changes you make to the environment are lost as soon as the second batch file ends. If you want to store results from the second batch file in an environment variable, you need CALL.

But wait—there's a *third* way to call another batch file and return to where you were. It's a little more trouble, but it maintains the environment and doesn't require DOS 3.3. First, your main batch file executes the secondary batch. The secondary file performs whatever processing it must and then re-executes the main batch file, including some kind of signal on the command line. The main batch file uses GOTO to jump to the line just after the one that executed the secondary batch file.

In the case of ANSRGET.BAT, the secondary batch file is temporary, created by the COPY command and deleted on the second pass. That fancy COPY command concatenates the line `SET ANSWER=` with whatever you type at the keyboard, adds the line `ANSRGET %ANSWER%` to the result, and saves it all as ANSSETEQ.BAT. For example, if you entered the string "PC MAGAZINE", the temporary batch file would contain the lines

```
SET ANSWER=PC MAGAZINE
ANSRGET %ANSWER%
```

ANSSETEQ.BAT creates the environment variable ANSWER and then calls ANSRGET again. On this second round, ANSRGET deletes the temporary batch file, displays the ANSWER variable, and then clears ANSWER from the environment.

There's one possible problem. The on-screen instructions tell the user to press <Enter>, <Ctrl-Z>, and then <Enter> again at the end of the input line. If the user omits the first <Enter>, the two lines of ANSSETEQ.BAT will run together. ANSRGET won't run a second time, and you'll end up with the environment variable ANSWER set to something like "PC MagazineANSRGET". The solution is simple: Add a blank line at the beginning of ANSRET.DAT.

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ANSRGET.BAT — COMPLETE LISTING

```
ECHO OFF
CLS
IF NOT %1.==. GOTO LOOP
ECHO What is your answer?
ECHO Type it in on a single line with a RETURN
ECHO Then press Ctrl-Z followed by the RETURN key
COPY ANSSETEQ.DAT+CON+ANSRET.DAT ANSSETEQ.BAT > NUL
ANSSETEQ.BAT
:LOOP
DEL ANSSETEQ.BAT
ECHO Your answer was "%answer%".  I can use it and
ECHO re-use it within this batch file -- see: "%answer%".
ECHO Now I will clear your answer...
SET answer=
```

Figure 2: This batch file puts user input into an environment variable without using features of DOS 3.3 or later versions.

by
Fran Finnegan

Windows

WRITE IN LIEU OF DEBUG

In the October 29, 1991, Windows column, you included a procedure for changing WIN.COM with DEBUG to bypass the Microsoft logo screen. Isn't it easier to use Windows Write as follows:

- Open WIN.COM
- Choose "No Conversion"
- Search for "LOGO"
- Change L to lowercase
- Save WIN.COM

I did it that way and it worked fine. It seems easier than the procedure described in the column.

Peter Ziebel
Hoboken, New Jersey

Since the reader who submitted the tip used DEBUG to describe his solution, and since techniques using DEBUG have been published here in the past, that method seemed appropriate. Using other editors to operate on binary files is equally valid, assuming you can carry out an equivalent procedure. If you're a Windows user who doesn't like to deal with binary file editors like DEBUG, Write does the job when you need to modify only *text* in a binary file (such as .COM, .EXE, and .DLL files).

In the instance mentioned, it is easier to use Write as your binary file editor. But only because nothing but text (the word *LOGO*) was changed.

Write won't help you with nontext byte changes, because you can't distinguish the non-ASCII characters on-screen; Write displays most non-ASCII characters as solid-block characters (or diamonds if you have *ATM* loaded). This is a side effect that results from how specific fonts are designed in Windows: Not all Windows fonts have a character bit-map specified for each of the 256 possible character values of a byte. If a character bitmap is not specified in a Windows font file for a particular byte, a default solid-block character bitmap is used. In that case, you will have no idea what the value of the byte being shown is. To see this, you can open any binary file with Write.

If you're changing only text characters, this limitation is not a problem. On the contrary, Write's ability to search for and globally replace text strings makes Write a lot easier to use than DEBUG. But if you use this feature, make sure your string lengths are the same.

The main caution in using Write as a binary file editor is that it's extremely easy to insert or delete a character by mistake. Write offers only insert mode; it does *not* offer an overwrite or replace mode. Inserting or deleting bytes in .COM, .EXE, and .DLL files, as well as in most other binary files essentially destroys the file. The string you enter must be the exact same length as the string you're replacing. Therefore, it is best to save a backup of the binary file before you start editing it. After editing the file, compare the sizes of the old and new files. If they are the exact same size, then you most likely didn't insert or delete anything by mistake.

- **WRITE IN LIEU OF DEBUG:** Windows Write can function as a binary file editor in place of DEBUG when you're only changing text.
- **SPREADING OUT ICON LABELS:** You don't have to wait for Windows 3.1 in order to get better icon-label spacing.
- **FILE MANAGER ON HUGE HARD DISKS:** Here's how to speed up the File Manager when you're using it with huge hard disks.

Also, if you prefer to use the Write Save As... option to save a duplicate of the file instead of making a backup beforehand, the Save As . . . dialog box has Text Only checked by default. That *doesn't* mean to save only the text strings in your binary file; it means to save the complete binary image of the file without any Write formatting information added. Since that's what you want to do, leave the mislabeled Text Only check box checked.

SPREADING OUT ICON LABELS

I'm a new Windows user and have a rather frustrating problem, one that even some experienced users I know don't seem to be able to solve. When I boot up my system and Windows starts up, the icons in Program Manager (Applications, Main, and so on) are in a row across the bottom, kind of smashed together, and are quite difficult to read. I have tried rearranging them and saving the configuration, but it doesn't seem to work. Every time I reboot, they appear again in the same smashed-together way! Is there any solution to this annoying problem?

Phil Rusche
Kenilworth, New Jersey

One solution to this problem is simply to rename the groups with shorter names. "NonWin" instead of "Non-Windows Applications," "Acc" instead of "Accessories," and so on. To do this, just close all the group windows, highlight one, and choose File, Properties.

Another way is to change the spacing of your icons, which you can do via an option in the Control Panel. Run the Control Panel's Desktop command, and find the Icon Spacing control in the resulting dialog box. The default icon spacing is 75 pixels. Change it to something larger (100, 125, or whatever). OK the change, and then exit and restart Windows for the change to take effect.

Once you do this, you will notice that your icons on the application workspace

Figure 1: As you can see from this snapshot of Windows 3.1's Program Manager, Program Item icon text will wrap, making it easier for you to keep your icons labeled and organized.

will now be spaced according to your new setting, but the icons *within* the group windows of Program Manager will not.

In Windows 3.1, the icon labels will actually wrap, so you will no longer have this problem. Figure 1 shows how it looks. This new label wrapping is the best solution of all!

FILE MANAGER ON HUGE HARD DISKS

Of the six computers in our office, the smallest hard disk capacity is 120MB. Three of the computers have 676MB disks partitioned into at least two logical drives each. With as many as 200 to 250 directories on a logical drive, each time one of us opens the File Manager, there is an annoying delay while it reads the directory structure. With Windows installed on drive C:, the File Manager loads the directories for drive C: automatically upon invocation. I often find myself needing to work on drive D: almost exclusively. Thus, to get at the files, I have to open the File Manager, wait a little while, click on drive D:, and wait a little while longer.

After some experimentation, my colleagues and I discovered a workaround that speeds up the File Manager: A separate Program Item can be created for each logical drive. These Program Items can be in the Main group or whatever group you wish. Simply select New from the File menu and choose Program Item. Enter some appropriate description, such as "FileMan—D:". Then enter

```
D:\WINFILE.EXE
```

for the command line, and press OK. Assuming Windows is installed on drive C:, Windows will issue a warning: "The specified path is invalid." Ignore this warning and press OK. Windows will still be able to find WINFILE.EXE even though you have indicated that it is in the root directory of D:.

> Starting with File Manager pointing to a RAM drive also reduces the amount of system resources that the Program Manager uses.

Happily, when File Manager subsequently opens, it will automatically load the directory structure information for drive D:, just as I want it to.

Eric Meyer
Nashville, Tennessee

PC MAGAZINE I use a modified version of Mr. Meyer's technique that I find preferable. Instead of having a separate Program Item icon for each logical drive, I simply changed the original File Manager command line to point to my RAM drive (logical drive G: on my machine), as follows:

```
G:\WINFILE.EXE
```

This causes File Manager to start up almost instantly! At that point, I then click on the drive I want to access. I find it easier to click on the File Manager drive icons than on the Program Manager program icons.

If you already have a RAM drive installed on your machine, changing the command line to point to it is simple. If you don't have a RAM drive installed, the Windows manual describes in great detail (in chapter 13) how to set one up (provided, of course, you have a sufficient amount of extra memory on your machine). Basically, you just add a line similar to the following example (which is for a 1MB RAM drive) to your CONFIG.SYS file:

```
Device=C:\WIN31\RAMDRIVE.SYS 1024
/e
```

There's a second reason why I prefer this method. Starting with File Manager pointing to a RAM drive also reduces the amount of system resources the Program Manager uses, because each Program Item icon in the Program Manager consumes FSRs (free system resources) at the time that its group window is opened to display it. (The actual amount of FSRs that are consumed depends upon how many programs are in the group, how long their names are, and which version of Windows you are using.)

If you have many logical drives on a huge disk, the drain on FSRs can be relatively significant. Since the FSR constraints will not be relaxed until Windows 3.1, it's a good idea to consider this approach.

OPENING WINDOWS

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by
M. David Stone

The Working Word

TWO-KEY MACROS IN WINWORD

Word for Windows is the most customizable word processor available, but it falls short in one respect: It doesn't have the ability to define two-key macro shortcuts. This is a real advantage of the macro feature in *Word* for DOS. It frees you from having to use arbitrary—and easily forgotten—key codes.

You can, for example, create a whole slew of print macros that start with P: Ctrl-P,S for Print Selection, Ctrl-P,P for Print Page, and so forth. By organizing the macros into groups and by using mnemonics, it's easy to remember a much larger number of macros than with the arbitrary keys you're forced into with single-key assignments.

Alas, *Word for Windows* 1.*x* drops the ball on this score, with single-key shortcuts only. Letting you use the Ctrl-Shift combination in addition to just Ctrl combinations (you can do this in *Word* 5.5, too) doubles the possible number of shortcut keys, but it doesn't help you remember them. If anything, it makes the job harder, since you also have to remember whether the macro is on a Ctrl key only, or a Ctrl-Shift combination.

Word for Windows 2.0 continues this oversight. But it does add a feature that lets you create two-key macros, although this wasn't the feature's intended use. The feature is the *push button*.

Briefly, in *Word for Windows* 2.0, as in 1.*x*, you can create a macro that will call up a dialog box. Unlike Version 1.*x*, however, 2.0 lets you use push buttons, with each button activated by a single keystroke. You can then use if-then logic to evaluate which button was pushed, and have the macro act accordingly. The result is equivalent to having two-key macros, though building the dialog boxes takes a little more work. Not so incidentally, for those who are still using Version 1.*x*, you can get almost the same effect with *option buttons*.

Here, then, is an example (shown in Figure 1) of how to squeeze two-key macros out of *Word for Windows* 2.0—and nearly squeeze them out of 1.*x*. For this example, I'll use some mnemonics from the *WordStar* "classic" Quick menu; however, this approach will work for any mnemonics that appeal to you.

TWO-KEY MACROS IN WINWORD: Emulate *WordStar*'s classic two-key Quick menu keyboard navigation mnemonics in *WinWord* 2.0. Also "2½-key" equivalents for 1.*x*.

THE MNEMONICS

For those who aren't familiar with the *WordStar* mnemonics, it will help to go over them briefly:

WordStar has two sets of cursor movement keys. One includes the arrow keys, PgUp, PgDn, and so forth. The other set uses the Ctrl key plus the typing keys, so that touch-typists can move around without having to move their hands away from the home keys. The basic movement keys are E, S, X, and D, which are arranged at the four points of the compass as follows:

```
        E
S               D
        X
```

This is the *WordStar diamond*, and the relative positions serve as a kind of geographical mnemonic, with S for left one letter, D for right one letter, E for up one line, and X for down one line. *WordStar* extends this diamond in several ways. The R key, just to the right of E on the keyboard, is PgUp in this scheme. The C key, just to the right of the X, is PgDn. *WordStar* takes these mnemonics a step

WORDSTAR QUICK KEYS FOR WINWORD 2.0 — COMPLETE LISTING

```
Sub MAIN
Begin Dialog UserDialog 411, 150, "Quick Menu"
          PushButton 260, 73, 98, 22, "&RTop of doc"
          PushButton 261, 125, 108, 22, "&CEnd of Doc"
          PushButton 95, 7, 88, 21, "&Previous"
          PushButton 13, 98, 103, 22, "&SLeft of Line"
          PushButton 133, 98, 114, 22, "&DRight of Line"
          PushButton 90, 73, 112, 21, "&ETop of Screen"
          PushButton 82, 125, 130, 21, "&XBottom of Screen"
          CancelButton 350, 2, 59, 22
End Dialog
Dim QuickMenu As UserDialog
Button = Dialog(QuickMenu)
          If Button = 1 Then
                    StartOfDocument
          ElseIf Button  = 2 Then
                    EndOfDocument
          ElseIf Button = 3 Then
                    GoBack
          ElseIf Button = 4 Then
                    StartOfLine
          ElseIf Button = 5 Then
                    EndOfLine
          ElseIf Button = 6 Then
                    StartOfWindow
          ElseIf Button = 7 Then
                    EndOfWindow
End If
End Sub
```

Figure 1: A *WinWord* 2.0 macro that duplicates *WordStar*'s two-key cursor key combinations.

further. Using Q for Quick, *WordStar* interprets Ctrl-Q, D (Quick Right) as the equivalent of the End key, to take you to the right side of the line; Ctrl-Q, S (Quick Left) takes you to the left side, and so on. In addition to these geographical mnemonics, we'll borrow one other mnemonic from the Quick menu: Ctrl=Q, P for Quick Previous (jump to previous position).

Creating macros for each of these functions is easy enough in *WinWord* 2.0, as is assigning them to hotkeys. The appropriate (and self-explanatory) WordBasic commands are StartOfLine, EndOfLine, StartOfWindow, EndOfWindow, StartOfDocument, EndOfDocument, and GoBack. The challenge is to assign these commands to two-key mnemonics.

BUILDING A DIALOG BOX

The first step for assigning the commands is to define a dialog box. In this case, that includes all the commands in Figure 1 that are located between the Begin Dialog and the End Dialog statements. If you haven't discovered this option yet, *Word for Windows* 2.0 comes with a separate dialog editor program that lets you interactively create dialog boxes by graphically manipulating buttons and a number of other objects on-screen. Once you're satisfied with the way the dialog box looks, you then copy it to the clipboard (it copies as text), and paste the definition from the clipboard into your macro editing screen.

Alternatively, you can define a dialog box in *WinWord* 2.0 by typing the appropriate statements, just as in Version 1.*x*. The syntax is straightforward, as Figure 1 shows. The Begin Dialog statement takes the following form:

```
Begin Dialog UserDialog [distance
from left], [distance from top],
width, height, ["title"]
```

Note that this information must be entered on a single line.

The *distance from left* and *distance from right* parameters are optional. If you do use them, they will specify a position for the upper-left corner of the box. The position 0, 0, for example, would place the corner of the box at the top-left corner of the current window. If you leave these out, *Word for Windows* centers the dialog box vertically and horizontally. The *title*, which must be in quotation marks, is also optional. If you choose to enter a title, it becomes the name for the dialog box. If you leave it out, *Word* uses the title "Microsoft Word."

The *width* and *height* are required. The maximum size that will fit on your screen will vary, depending on your screen driver. Using one board and a Super VGA driver, the largest dialog box I could fit on a screen was 790 by 402. Using another board and a VGA driver, the largest was 840 by 400. You can experiment with the settings to find out what fits on your system. In general, if you create a dialog box directly, rather than with the dialog editor, you'll want to start with a larger size than you need and then trim it to fit on your screen.

The syntax for defining each push button is actually quite similar to the syntax for the Begin Dialog statement and takes the form

```
PushButton DistanceFromLeft,
 DistanceFromTop, width, height,
 "text"
```

with all this information entered on one line, as above. Here, DistanceFromLeft and DistanceFromTop specify a position within the dialog box, so 0, 0, would put the upper-left corner of the button in the upper-left corner of the box. Since the push button command doesn't provide defaults for these parameters, they are required. *Width* and *height* specify the size of the button—which you'll want to make large enough to show the text. (As with the dialog box itself, the appropriate height and width will vary, depending on your board and screen driver.) The *text* (which must be in quotation marks) is what appears on the push button. To designate a letter that you can type to activate each button, simply put an ampersand in front of that letter.

Note the Cancel button as the last line before the End Dialog statement. That's important, since it lets you escape out of the dialog box without giving a command. End Dialog marks the end of the definition. The next two lines

```
Dim QuickMenu As UserDialog
Button = Dialog(QuickMenu)
```

assign the name QuickMenu to the dialog box you just defined and call up the dialog box, as shown in Figure 2. The macro then waits for you to choose a push button. When you do, the value of that push button is returned for the macro to evaluate. The values are assigned to the buttons in the order you define them, starting with 1.

The rest of the macro is a straightforward example of an If...ElseIf...EndIf statement. It simply tests for the value of the button you chose and acts accordingly. If you chose button 1, the macro will follow the StartOfDocument command; if you chose button 2, it will follow the EndOfDocument command, and so on. As the finishing touch, assign the dialog box to the shortcut key Ctrl-Q or Ctrl-Shift-Q. Now typing the shortcut key will call up the dialog box, and typing a second key will activate the appropriate push button.

For those who haven't moved up to *WinWord* 2.0 as yet, Figure 3 shows a

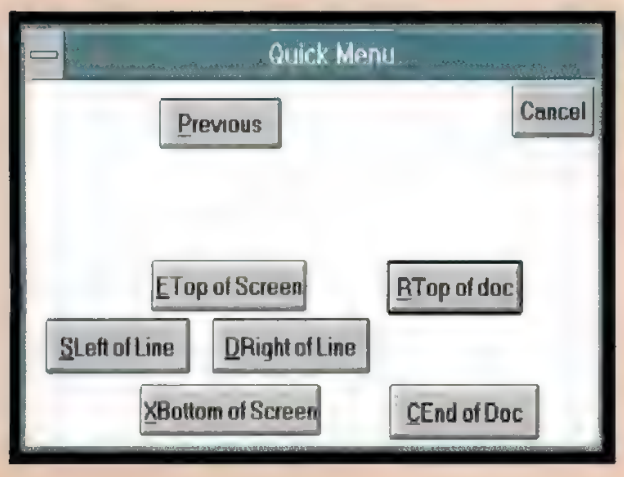

Figure 2: This dialog box results from the macro in Figure 1. It reproduces the *WordStar* diamond and other cursor movement keys.

WORDSTAR QUICK KEYS FOR WINWORD 1.X — COMPLETE LISTING

```
Sub MAIN
Begin Dialog UserDialog 411, 150
          OptionGroup .OptionGroup1
          OptionButton 260, 73, 98, 22, "&RTop of doc"
          OptionButton 261, 125, 108, 22, "&CEnd of Doc"
          OptionButton 95, 7, 88, 21, "&Previous"
          OptionButton 13, 98, 103, 22, "&SLeft of Line"
          OptionButton 133, 98, 124, 22, "&DRight of Line"
          OptionButton 90, 73, 127, 21, "&ETop of Screen"
          OptionButton 82, 125, 145, 21, "&XBottom of Screen"
          CancelButton 350, 2, 59, 22
          OKButton 350, 30, 36, 22
End Dialog
Dim QuickMenu As UserDialog
On Error Goto ForgetIt
Dialog QuickMenu
          If QuickMenu.OptionGroup1 = 0 Then
                    StartOfDocument
          ElseIf QuickMenu.OptionGroup1 = 1 Then
                    EndofDocument
          ElseIf QuickMenu.OptionGroup1 = 2 Then
                    GoBack
          ElseIf QuickMenu.OptionGroup1 = 3 Then
                    StartOfLine
          ElseIf QuickMenu.OptionGroup1 = 4 Then
                    EndOfLine
          ElseIf QuickMenu.OptionGroup1 = 5 Then
                    StartOfWindow
          ElseIf QuickMenu.OptionGroup1 = 6 Then
                    EndOfWindow
End If
Forgetit:
End Sub
```

Figure 3 : This *WinWord* 1.*x* macro provides "two-and-a-half" key cursor movement to almost duplicate *WordStar*'s cursor-movement key combinations.

macro that will provide nearly the same functionality in *Word for Windows* 1.*x*. It does this by substituting option buttons for the push buttons that 1.*x* lacks. Note that the syntax and logic in Figure 3 parallel Figure 1. The only functional difference is that after choosing an option button, you'll have to hit Enter for the macro to finish. Think of these as "two-and-a-half-key" macro assignments.

One other difference is the addition of an On Error statement (On Error Goto ForgetIt) just before the Dialog QuickMenu command, which displays the dialog box on-screen. Without this statement, *Word* will show you an error message if you choose Cancel rather than OK. With it, the macro will jump to the label ForgetIt, without showing an error message.

Note that you don't need an On Error statement or a label to jump to in the first macro. However, you would need them if one of your push buttons called up another dialog box. For example, if you follow *WordStar*'s mnemonic for Quick Find and add a push button that opens a Find dialog box, you get an error message if you choose Cancel in that dialog box, unless you've added an appropriate On Error statement to the macro. In general, the On Error statement should go just before the line that calls up the dialog box. The label to jump to should go near the end of the macro.

One of the nicer features of using dialog boxes to create two-key macros is that you automatically get what amounts to a help screen. If you know the second keystroke, and you type both keystrokes quickly, you'll never see the dialog box on-screen. But if you hesitate after the first keystroke, the dialog box will show up, so you can see your choices.

TIPS FROM WORKING WORDSMITHS

Tell the Working Word your latest word processing discovery; we'll pay you $50 for any tip we print. Please send your contribution on-disk along with a printout to The Working Word, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload it to PC MagNet (see page 10 for access instructions). We regret that we are unable to acknowledge submissions or answer questions individually. ■

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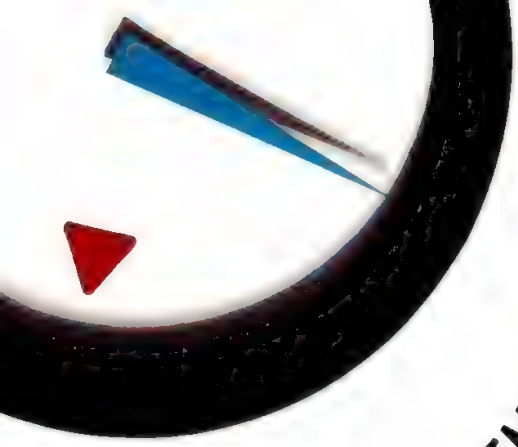

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CIRCLE 732 ON READER SERVICE CARD

by
Craig Stinson

Spreadsheets

AN EXCEL-TO-1-2-3 TRANSLATION BUG

I have apparently stumbled upon a bug in *Microsoft Excel* 3.0 or *Lotus 1-2-3* (Versions 2.01 and 2.2) regarding absolute addresses. When I create an *Excel* 3.0 worksheet with absolute addresses and save it as a .WK1 file, the addresses are sometimes translated incorrectly in *Lotus 1-2-3* (Versions 2.01 and 2.2).

For example, I have an *Excel* file that includes the following:

	A	B
1		
2	=B2	100

The first row is blank. The value shown in A2 should be 100.

I save this file in .WK1 format and retrieve it in *1-2-3*. Now I see the following:

	A	B
1		
2	0	100

The reference in A2 is now B1, rather than the B2 I started with.

The problem does not occur if the first row of the *Excel* worksheet has data. But under some other circumstances, the reference in the *1-2-3* worksheet is off by as much as three rows.

This can cause a lot of grief! My confidence in both products has fallen.

Brian Wilson
Smithville, Texas

PC MAGAZINE Well, you've certainly turned up a bug, and your diminished confidence in *Excel* is not unwarranted. But don't disparage *1-2-3*; the inaccuracy is clearly *Excel*'s problem. Thanks for bringing this to our attention.

It's a good idea to treat any file-translation utility, whether supplied by a third party or built into a spreadsheet program, as somewhat suspect. Check out the converted worksheet carefully before committing any critical task to it.

- **AN EXCEL-TO-1-2-3 TRANSLATION BUG:** When you save an *Excel* sheet as a .WK1 file, you may find incorrect cell references.
- **NAVIGATING LOCKED TEMPLATES:** There's an easy way for the user to get to the cells he can change in a protected *Excel* template.
- **DIRECTORY MENUS IN 1-2-3:** A macro that saves you from having to remember long directory pathnames.
- **ZEROS FOR REGRESSION:** A quick way to fill blank cells in *Lotus 1-2-3* with 0s so that the /Data Regression command works.
- **A LITTLE-KNOWN EXCEL SHORTCUT:** Switch between displaying formulas and values.

NAVIGATING LOCKED TEMPLATES

Templates in *Excel* 3.0 make it easy to set up standard forms that can be filled in by relatively untrained users. The way to make such forms "bulletproof" is to unlock all cells that the user is allowed to change, then use the Options Protect Document command to turn protection on for the rest of the worksheet. Save the worksheet as a template, using the Options button in the File Save As dialog box.

The only problem is that there is no documented way for the user to find the unlocked cells, and it can be frustrating to select them by trial and error. Fortunately, the Tab key is an undocumented way to move between unlocked cells, automatically jumping over intervening locked cells.

John Navas
Dublin, California

PC MAGAZINE The feature Mr. Navas describes is *Excel*'s approximate equivalent to the *1-2-3* /Range Input command. You'll find this is mentioned under /Range Input in the on-line *1-2-3* Help system.

There may be a word or two about it *somewhere* in the *Excel* manuals—but, like Mr. Navas, I haven't been able to find it! In any case, it's a handy thing to know about if you create data entry templates for untrained users. On a protected worksheet, the Tab key restricts navigation to unlocked cells. Users may still move to locked cells by pressing the arrow keys or selecting those cells with the mouse, but the Tab key always takes you directly to the next unlocked cell.

DIRECTORY MENUS IN 1-2-3

On a number of occasions, I have worked with clients who had very complex subdirectory systems with many levels and multiple drives. While working in *Lotus 1-2-3*, these users may need to change drives and directories many times. Remembering the correct path into each subdirectory was often difficult, and even if they did remember it, there was always the possibility of misspelling part of the path. *1-2-3*, Release 2.2, is not kind when you misspell a pathname; it makes you start the whole thing over, which leads to a lot of user frustration.

To make things easier for my clients, I designed the macro menu system shown in Figure 1. I assigned the names \0 and \D to the macro—\0 so it would execute automatically when the file is retrieved and \D so it could be run again at any time.

The macro presents users with a choice of the directories they use most often. It

DIRMENU.WK1 COMPLETE LISTING

```
        A                                                  C
1   \0        {menubranch menu1}
2
3   menu1     1-Budget                              2-Personal
4             Budget directory                      Personal directory
5             /fd                                   /fd
6             c:\sheets\lotus22\data\bob\budget~    d:\company\data\personal~


              D                          E                    F
1
2
3  3-Finance                        4-123W          5-Default directory
4  Finance directory                123W directory  Stay in default directory
5  /fd                              /fd             {quit}
6  d:\private\depts\workshee\finance~ e:\123w\work~
```

Fgure 1: This *Lotus 1-2-3* macro presents a directory menu. Since it was too wide, we've split the macro into two chunks here; rows 1 through 6 should align horizontally as one long range.

also allows the user to remain in the default directory by choosing option 5.

Shane Devenshire
Walnut Creek, California

This is a useful idea for anyone who works in several *1-2-3* directories. I would suggest one embellishment: Add

```
/FR{name}
```

to B7, C7, and D7. This way, after switching data directories, the macro will invoke the /File Retrieve command and then present a full-screen list of the worksheet files in the selected directory.

ZEROS FOR REGRESSION

For clarity and ease of entry, most people probably leave blank any cell in a *Lotus 1-2-3* spreadsheet for which there is no value—that is, for which the actual value is zero. When you're doing regression analysis, however, you can't leave zero values blank. That's because the /Data Regression command doesn't work unless the dependent-variable range and each independent-variable range have exactly the same number of numerical entries.

To fill these empty spaces with 0s, I created a macro that marched through the file, checking each cell to see whether it was blank. Wherever a blank was found, the macro would enter a 0. This tunnel-vision, rigidly linear-thinking approach took an eternity in a large file, so my son (who will get the check if you publish this item) suggested a much more elegant solution:

Create a file called ZERO.WK1 that has the same number of rows and columns as the worksheet in which you're doing the regression. Next, use /Data Fill or /Copy to fill ZERO.WK1 with 0s. Finally, use /File Combine Add Entire to combine ZERO.WK1 with the regression file. Any blank cells in the regression file automatically turn to 0s. This works like a charm, is very fast, and shows the old man that he is not omniscient!

Scott M. Eddie
Toronto, Ontario, Canada

Well, it's not every day we receive ideas that serve so many valuable purposes at once! The younger Mr. Eddie's suggestion does indeed work like a charm. And if you really don't like looking at those 0s, you can use one of *1-2-3*'s commands to make the worksheet look the way it did before you combined it with ZERO.WK1.

The command /Worksheet Global Zero Yes makes all cells with values exactly equal to zero appear blank. Unfortunately, you have to run this command anew with each session. Your preference regarding the display of zero values is not saved when you use the /File Save command.

One way to keep the display zero values permanently suppressed is to write the following simple macro:

```
'\0     /WGZY
```

Naming the macro \0 makes it execute automatically whenever your file is retrieved.

A LITTLE-KNOWN EXCEL SHORTCUT

Normally when you look at a *Microsoft Excel* macro sheet, you see the text of the formulas that make up the macro. If you pull down the Options menu, choose Display, and deselect the Formulas check box, you can see what each macro statement evaluated to the last time the macro was run. If the macro ended abnormally, any value other than TRUE will tell you where the problem occurred—and often the nature of the error as well.

While this is discussed in the documentation, there's a valuable keyboard shortcut that's hardly mentioned at all. The key combination Ctrl-Backquote (Ctrl-') toggles the display between formulas and values. The only place this shortcut is documented is on the *Excel* keyboard template, and it's an easy one to miss. Pressing Ctrl-' (on most keyboards, the backquote is on the same key as the tilde, just above the Tab key) saves a lot of mouse clicks or keystrokes. Every little bit helps!

Joan S. O'Connell
Watertown, Massachusetts

Yes, if you do anything with *Excel* macros beyond simple recordings, you will really appreciate this shortcut. (You can use it on ordinary worksheets, as well.) With Ctrl-', you can flip back and forth between a macro sheet's "formula layer" and "result layer" without taking your eye off the screen. The result layer provides all kinds of useful diagnostic information. As Ms. O'Connell notes, it can help you figure out the nature of a macro-terminating error. If you create variables on the macro sheet (loop counters, for example), the result layer can also help you track down pesky logic bugs that don't actually stop the macro. It's nothing like a true debugger, but every little bit does indeed help.

Who knows? Maybe *Excel* 4.0 will actually include a table of keyboard shortcuts in the manual. In the meantime, if you lose that keyboard template, check out the Keyboard command on the Help menu.

HINTS, TIPS, QUESTIONS

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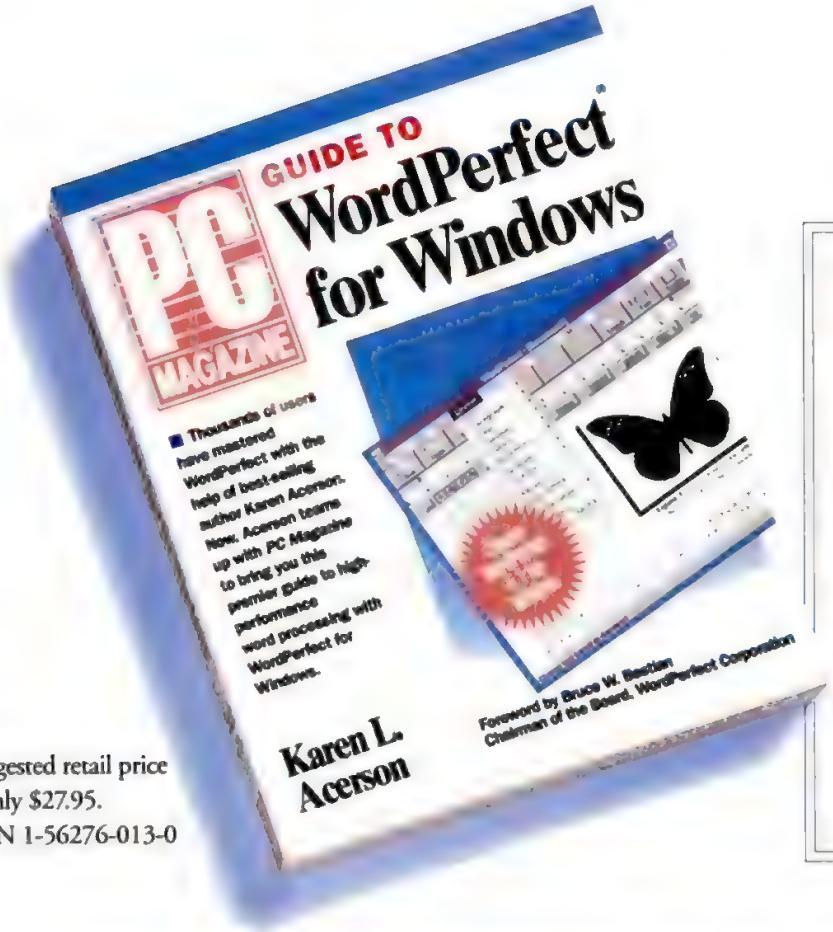

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CIRCLE 183 ON READER SERVICE CARD

by
Frank J. Derfler, Jr.

Connectivity

HANDLING FILE HANDLES

Here's a subtle problem that turned out to be the root of many mysterious problems on our network: redirecting command line output to a NUL file.

I coadminister a LAN running *NetWare* 3.11 on which PC programs were locking up for no apparent reason, though they occasionally complained of not enough files. Most of our programs run through batch files that typically redirect the output to the NUL file to keep the users from seeing unnecessary details.

After some detective work, I found that DOS had too many files open. In addition to the four basic files our PCs held open (AUX, CON, PRN, @!NETW!@), the NUL file had many other entries. It turns out that these entries were the result of redirection to NUL from the batch files.

The source of the problem was the many TSRs we were loading from the batch files. Every time we started one and redirected its output to NUL, the associated NUL file was never closed and we were left with one less file handle. Most notably, we use a program called PUSHD, which stores the current directory on a stack and changes to a specified directory. A related program, POPD, recalls the top directory from the stack and moves to it. After loading several batch files, our limit of 50 file handles was quickly reached.

As an example, here's our *Harvard Graphics* batch file:

```
@ECHO OFF
PUSHD C:\HG3 > NUL
HG3 %1 %2 %3 %4 %5
POPD > NUL
```

Lines 2 and 4 cause the problem. The two programs each open a NUL file, but because they are TSRs, the files don't get closed. The bottom line is, be careful when you redirect output to NUL. Be sure that you're not loading a TSR that can't clean up after itself.

Odin Anderson
Madison, Wisconsin

- **HANDLING FILE HANDLES:** Applications can lock up when they run out of file handles; TSRs may be the culprits.
- **AFFORDABLE COMMUNICATIONS:** Modems that combine data and fax capabilities are cost-effective solutions.
- **REMOTE PRINTING REVISITED:** Here's another way to set up *NetWare*'s remote printer utilities.
- **GOOD CONNECTIONS:** Solid Ethernet connections depend on good hardware.

PC MAGAZINE Unfortunately, you can't predict how every application will behave when it runs out of DOS file handles. The problem is worse on networked PCs, because the layers of networking software take file handles; the problem reaches its peak on networked PCs acting as file and print servers. Several DOS-based LANs recommend entering FILES = 99 in the CONFIG.SYS file of a PC acting as a server.

If you are faced with networked PCs that mysteriously freeze in the middle of an application, particularly if the user just initiated a program function that tries to open an overlay or spool file, try increasing the FILES = statement to 50 or more. Increasing files from the default of 25 to 50 or so will take about 2K of conventional memory, but it's worth it. Programs like *System Sleuth Pro* from Dariana Technology (714-994-7400) or *CheckIt* from TouchStone Software Corp. (714-994-7746) can help you uncover TSRs that are holding file handles open.

AFFORDABLE COMMUNICATIONS

I'd like to do simple communications via modem as well as send and receive faxes. What is the most straightforward way to handle these tasks with the minimal amount of hardware and software, preferably within the Windows environment? Speed isn't as important as affordability.

James H. Arnold
Lee's Summit, Missouri

PC MAGAZINE Companies like Intel, Megahertz, and VenTel sell products that combine data modem and fax modem capabilities in a single unit. The marriage of data and fax modem technologies is more a matter of convenience than logic, but it works. It's also a cost-effective solution, especially since the hardware generally comes with bundled software for both functions.

Some people would rather use separate modems for data and fax, for two reasons. Keeping the functions separate lets you split or combine the lines for incoming data and fax calls—particularly in back of a PBX. Using separate data and fax modems also lets you upgrade to faster data modem technology, without worrying about the interface to the fax device.

Sending faxes from within applications, particularly Windows applications, is a joy. If you can see it on-screen, you can send it as a fax. The software bundled with products like Intel's SatisFAXtion board is fully integrated into the Windows environment. Receiving faxes is more complicated, but Intel's SatisFAXtion software does a good job and is a good choice for standalone systems. Call Intel at 408-765-8080 for details.

By the way, anyone using networked PCs should consider a fax server instead of separate fax boards. One of the best

systems for sending and receiving faxes on a network is included in *Right Hand Man*, a personal information manager by Futuris Inc. (504-837-1554). *Right Hand Man* provides electronic mail, workgroup scheduling, shared telephone directories, and one of the nicest fax viewers I've used. Futuris has just released an excellent Windows version of *Right Hand Man;* the company has a marketing and development relationship with OAZ Communications (510-226-0171), whose NetFax product provides complete network fax gateway capabilities.

REMOTE PRINTING REVISITED

This is in response to a letter you published in the October 15, 1991, issue, "Remote Printing on a NetWare LAN." The letter was correct in its content, but I want to share another idea. Instead of copying the necessary files to each remote print server's boot disk, I copy the files to the SYS:LOGIN directory. Then when the networked PC runs IPX.COM and NETx.COM, you can use a batch file to change to drive F: and run RPRINTER. If the network has reasonable throughput, the RPRINTER software should load faster from the network than from a floppy disk. This arrangement also makes it easier to update RPRINTER. You can copy the PSERVER files to SYS:LOGIN to make them accessible to your print servers.

Greg Stocking
Raleigh, North Carolina

The original suggestion in the October column was aimed at setting up an RPRINTER workstation that wasn't logged into the network in order to simplify administration and security control. This arrangement meets the same goals. Putting those files in SYS:LOGIN bothers my sense of organization, but it works!

GOOD CONNECTIONS

Despite the popularity of the 10BaseT unshielded twisted-pair wiring plan, plenty of installations still use thin Ethernet cabling. Thinnet, unshielded twisted pair, and all other wiring schemes suffer from their own peculiar problems, but I repeatedly see three types of problems associated with thin Ethernet coaxial cable: bad crimp connections, intermittent T-connectors, and strained connections between the T-connector and the LAN adapter card.

It isn't hard to make good crimp connections on coaxial cable, but you need the right tool to get consistent results. Simply stated, you slide a metal sleeve over the prepared end of the cable, line up the hardware elements of the connector, and use a device like a pair of pliers with a special jaw to crimp the sleeve so it makes a solid connection with the cable.

Good-quality crimping tools have a racheting handle that exerts great force while reducing the amount of physical effort required. Expect to pay well over $100 for a good crimping tool. Don't buy a crimping tool without a racheting handle or without a full-length jaw to compress the entire sleeve in one even squeeze.

You must also pick the correct die for the tool and the correct hardware for the cable. Several types of coaxial cable look alike superficially. The RG-62 cable used for ARCnet and for cable television has a slightly greater diameter than the RG-58 typically used for thin Ethernet, and you must have a different die in the jaws of the crimping tool and the right hardware to get a good fit.

Figure 1: Use these new Ethernet connectors to make more reliable LAN connections.

There are even differences among the types of thin Ethernet cabling. Cable with Teflon insulation is slightly smaller than cable with plastic insulation; cable conforming specifically to the IEEE 802.3 specification instead of to the older "RG" industry specification is even thinner than RG-58 and requires its own crimping tools and hardware.

Bad T-connectors can cause high levels of frustration among network administrators because the problems they cause are often intermittent. The T-connector can make and lose its connections when someone hits the cable under the desk with his feet, when the LAN cable moves as it tangles in telephone cords, or even as the room heats and cools.

Under *NetWare*, the file server software can recognize a disconnected cable on a server LAN adapter and can warn of fragmented packets sent through intermittent connectors. Under *LANtastic*, the LANCHECK utility can help uncover bad connections. But the best protection against bad connections is good hardware. T-connectors should have a reinforcing ring at the junction of the T and the barrel and a strong lip on the male end to help prevent cracking under the constant load of the cable's weight.

The poor connection between the T-connector and the LAN adapter card often results from the tight fit between the right angle T-connector and other cables attached to cards in the expansion slots. Trying to attach a SCSI cable, a thin Ethernet cable, and a video cable to the back of a PC with a small cabinet presents a real challenge. I've even seen adapters tilted out of the expansion bus—which can damage the entire computer—by snug cables with forced connections.

I recently found a clever way to avoid these types of poor connections. Oasis Computer Products (619-279-7400) markets two Ethernet connectors that have a completely different configuration from the typical T shape: See the photograph in Figure 1. Oasis's Y-Connector and F-Connector, $9.95 each, let you connect both thin Ethernet cables from one side or directly from the rear instead of spreading them out at right angles.

The Y- and F-Connectors work particularly well with external LAN adapters that have a power connector sticking out of the back. They're great for small laptop and notebook computers. Providing alternative configurations for the cable connections is so valuable and simple an idea, you have to wonder why these connectors took so long to get to market.

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay $50 for any tip we print. Please submit your letter on-disk along with a printout. Then mail your contribution to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016. You may also contact Frank J. Derfler, Jr. via MCI Mail (MCI ID: 240-2931) or the LAN Labs fax machine (904-837-0737). ■

by
Theresa W. Carey

PC MagNet

OFTEN-ASKED QUESTIONS

Have you put off logging on to PC MagNet because you're unsure of how to get around? Or maybe you have been on-line but were confused by the variety of information and services available?

The ZiffNet Road Map in the January 14, 1992, PC MagNet column is one good way to become familiar with PC MagNet. To learn how to best navigate it, download the quick reference cards available in the Utilforum/Tips, Data Library 1 (General Info). The filename for the ASCII version is QREF.TXT.

Meanwhile, here are answers to some of the more common questions PC MagNet's sysops are asked by newcomers.

Sometimes I can't find a file mentioned in the Utilities section of PC Magazine. *What am I doing wrong?*

Every so often, a file mentioned here in *PC Magazine* is given a different filename before it is uploaded to PC MagNet. This happens mainly for two reasons: It either duplicates a filename already on PC MagNet, or it is too long. CompuServe Information Services, which hosts PC MagNet, has a 6-character limitation on filenames. So any 8-character filenames that appear in *PC Magazine* have to be shortened before they can be uploaded.

Filename changes are one good reason to read the forum flash announcements that appear when you first enter a forum. In these announcements, we often note any discrepancies between a published filename and its on-line filename. However, if you're already on-line and having trouble locating a file, you can also find this information in the Utilforum/Tips Forum Announcements area. You can get to this area by typing ANN from the Forum or Messages prompts. If you use the *CompuServe Information Manager* (*CIM*), you can read forum announcements by double-clicking on the "New Notices!" button.

Unfortunately, these announcements can't act as an index for all filenames that have been changed. Therefore, if you're having trouble finding a file from an older issue, browse the forum library or the Utilities database (SOFTLIB) using the keyword search feature, or a wildcard name search.

■ OFTEN-ASKED QUESTIONS: Here are the answers to some of the most-commonly asked questions about PC MagNet.

Where can I get help on-line?

The short answer to this question is to simply type GO HELP. Once in the Help area, you will be presented with a menu of options that let you browse our on-line manual, look up phone numbers, and talk to customer service, among other things. Note that you can use the Help area without incurring connect charges. If you'd prefer to simply access the manual, enter GO MAG1 at any prompt. Then follow the menus and you'll get a summary of all the ZiffNet commands.

Another resource for on-line help is the Practice forum. Here you can practice using the forum message areas and library areas—again, without incurring connect charges.

Of course, you can always ask the sysops; they are on-line to help you find your way around the service and help solve problems you may run into.

I have a CompuServe account. Are there any extra charges associated with using the PC MagNet forums?

No, there's no charge to cross the gateway from CIS to PC MagNet. And there are no additional charges above and beyond those that PC MagNet users pay; most of the PC MagNet resources are open to anyone at no extra charge. For example, the forums (Editorial, Programming, Utilforum/Tips, and After Hours), software library (SOFTLIB), reviews database (ZiffNet Product Reviews Database) and news area (Newsbytes) are all charged at the regular rate of $12.80 per hour for 1,200- and 2,400-bps service or $6.30 per hour for 300 bps service. There are a few surcharged areas, such as Computer Library, but you are alerted to the extra charges before you access them.

What does PC MagNet's Editorial Forum encompass?

A forum is a place where people can exchange information, share software programs, and participate in discussions. *PC Magazine*'s forums vary in their focus and content, but have a similar structure and use the same commands. Once you learn how one forum works, you've learned them all.

Each forum has Libraries, Message Sections, Announcements, and Instructions areas. Files are stored in the libraries, and organized by their source. For example, if you're looking for a file mentioned in the User-to-User column, you would select the User-to-User menu option; if you were looking for an ASP utility, you would select the ASP Utilities option. Once in the library, you can scan or browse through the files, download them, and so on. If at any time you are unsure of your options, simply type ? at the prompt.

Conversations among forum members take place in the Message area, and are grouped into sections organized by category. Usually a Message Section has a corresponding library with the same name and number.

The Announcements area is the place to find notices from the sysops regarding policies and personnel lists. The Instructions area gives you a summary of the commands. From here, you can also type GO PRACTICE and experiment with these areas, free of connect charge. ■

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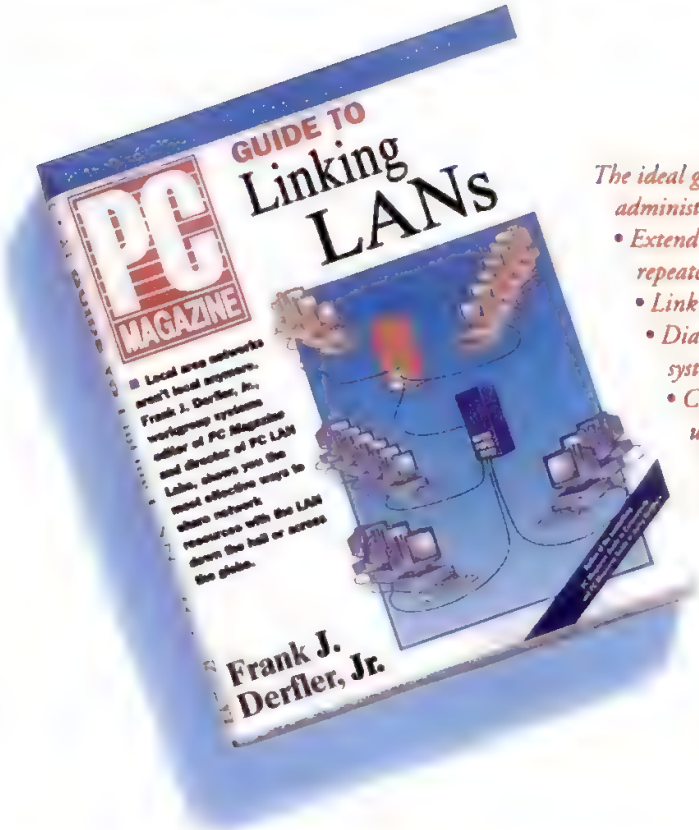

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CIRCLE 354 ON READER SERVICE CARD

by
Terry Lahman and
Kevin Sims

Utilities

PCREMOT2 Transfers Files from Your Office To Your Home

Have you ever tried to catch up on your work at home, only to find yourself at a standstill because you forgot to take a certain file from your PC in the office? Now you can avoid this with PCREMOT2, the newly upgraded version of *PC Magazine*'s popular PCREMOTE utility.

The original PCREMOTE simply let you *control* a host computer from your home PC through a pair of modems. After dialing up the machine in the office and entering the password, everything on the host computer's screen would also be displayed on your remote computer's screen. While the keyboard on the host machine remained fully operational, any key you pressed at your remote site would also be passed to the host computer for processing. That meant you could run applications on the host and see the results on your screen at home.

PCREMOT2 adds the missing element: two-way file-transfer capability. In addition, PCREMOT2 provides support for modem speeds up to 9,600 bits per second, communications ports 3 and 4, a facility to retransmit the screen of the host computer (in case of phone-line noise), a shell-to-DOS capability for your remote computer, and local three-wire null-modem cable communications.

Rather than invent a new file-transfer protocol, PCREMOT2 uses a separate program, ZCOPY, to implement its file-transfer services. A proven performer, ZCOPY originally appeared in the February 28, 1989, Utilities column. One of the significant advantages of using ZCOPY is that the host mode size of PCREMOT2 remains very small: only 8K. This allows you to execute large application programs without worrying about running out of memory. Had PCREMOT2 and ZCOPY been combined, the size of the resulting TSR program might have presented a problem with large applications.

PCREMOT2 is not backward-compatible with the original PCREMOTE (Utilities, January 16, 1990), so you must put PCREMOT2 on the host and on the remote computer. (As in the earlier article, I'll refer to the office-based machine you wish to control as the *host*. The controlling computer, at whose keyboard you'll be sitting at home, will be called the *remote* machine.) As before, PCREMOT2 can run only text-based applications on the host in 25-row by 80-column display mode; it can't handle graphics-based programs such as Windows 3.0. You can, of course, *transfer* any kind of file between machines, but the file transfer operates in the foreground; PCREMOT2 cannot transfer files in the background.

> ■ Don't risk forgetting a file at the office: Run PCREMOT2 before you leave. With added file-transfer capabilities, more COM ports, and higher speeds, this upgrade of our popular PCREMOTE utility lets you get the files you need when you need them.

You can download PCREMOT2.COM, ZCOPY.COM, and the companion SETUP.EXE program used to configure PCREMOT2 from PC MagNet, as explained in the sidebar "Downloading Utilities." All three files are included in the PCREM2.ZIP file, which also includes their source code. (PCREMOT2 and ZCOPY are written in assembly language. SETUP, used to configure PCREMOT2, is written in C.) If you don't have a modem, the source code is also available by mail or fax: just send a postcard with your name and address to the attention of Katherine West, Utilities, *PC Magazine*, One Park Ave., New York, NY 10016. Assembling PCREMOT2.ASM and ZCOPY.ASM requires a macro assembler (IBM or Microsoft, Version 4.0 or later); you'll need Microsoft C, Version 5.1 or 6.0, to compile SETUP.EXE.

USING PCREMOT2

Although command line parameters are provided that allow complete control of PCREMOT2, you may find it easier to use SETUP.EXE to configure PCREMOT2 and store the desired settings directly in the PCREMOT2.COM file as defaults. (Using SETUP will be explained later.) The complete syntax for PCREMOT2 is

```
PCREMOT2 [/M] [/x] [/Bx] [/D] [/S]
  [/N] [/U] [/?]
```

The command line parameters, each preceded by a forward slash (/), may be entered in any order and need not be capitalized.

By default, PCREMOT2 installs itself as a memory-resident program on the host computer. Use the /M parameter when you run the program on the remote machine. This switch causes the computer to bring up the program in *manned* mode. You will then be prompted to enter the phone number to dial up the host.

The /*x* parameter sets the communications port for the modem, for example, /2 for COM port 2. PCREMOT2 supports

COM ports 1 through 4; the default is COM 1. Note that if you select COM ports 3 and 4 you must be sure that the interrupt for the port is not shared with any other device. If an interrupt is shared, PCREMOT2 may not work at all, or you may get missing characters or garbage on the screen. (Screen garbage can also be the result of noisy phone lines, power surges, power brownouts, poor wiring from the computer to the modem, or modem malfunctions.)

The /B*x* parameter allows you to select from a number of baud rates: /B1 (1,200 bps, the default); /B2 (2,400 bps); /B4 (4,800 bps); or /B9 (9,600 bps). PCREMOT2 will automatically switch the host modem speed down to that of the remote modem, if necessary. Thus, if you leave your office computer in host mode to answer at 9,600 bps and have only a 2,400-bps modem at home, upon connection of the two systems, PCREMOT2 will synchronize the machines at 2,400 bps.

PCREMOT2 provides an area for up to 30 characters in which you can enter the special setup string required by some high-speed modems. To add such a setup string to PCREMOT2, however, you must select Option 12, "modem setup string," of the SETUP program; the string cannot be entered via the command line.

The /D parameter sets the desnow flag, which is required for those CGA systems that exhibit snow when using PCREMOT2. By default, this flag is not set. Setting the desnow flag slows program execution and increases the time it takes to update the remote computer, for it causes the program to wait for horizontal retrace before transferring a byte of data to or from the video RAM. Fortunately, use of the desnow option on the host computer is necessary only if someone will be watching a CGA screen on that machine—as during a training session, for example. Using the /D option on the remote computer does not affect the program execution speed on the host.

During testing and everyday use of PCREMOT2, I occasionally became confused as to whether the display on my screen was its own or that of the host computer, relayed via PCREMOT2. Specifying the /S parameter adds the smile face character in the upper-right corner of the screen as a reminder that PCREMOT2 is running. This also serves as a warning to anyone who might try to use the host computer while the remote computer is still connected and active.

By default, PCREMOT2 assumes that the host and remote computers are connected via a pair of modems. The /N parameter configures PCREMOT2 instead for use with a null-modem cable, which permits connecting two machines locally, through a standard null-modem cable. While I originally intended this modemless connection facility as a temporary measure during the development of PCREMOT2, many readers asked me to retain it.

When the /N switch is specified, PCREMOT2 skips all the modem commands and operates as if the phone number had already been dialed and two modems had connected. Note that to run PCREMOT2 using a null-modem cable, both computers must use the /N parameter on the command line (or via SETUP) and both must be explicitly set to the same baud rate parameter (/B*x*).

You can uninstall PCREMOT2 from the host system without rebooting by entering PCREMOT2 /U. Note that this can be done only if PCREMOT2 is the last resident program loaded on your computer. Entering a question mark as a parameter, with or without the preceding forward slash, brings up a syntax help screen.

SPECIAL KEYS

During operation, four Alt-key combinations are used to activate the various PCREMOT2 functions. The SETUP program lets you change the Alt-key combinations, should there be a conflict with one of your programs. By default, pressing Alt-C causes retransmission of the entire host screen. This may occasionally be necessary if you have a noisy phone line that corrupts part of the display. Alt-X is used to exit PCREMOT2. Alt-S shells the remote computer to DOS, which allows you to execute programs, check filenames, or exit from remote operation without disconnecting the phone line between the two machines. To return to PCREMOT2 and regain control of the host computer, type EXIT at the DOS prompt.

Alt-T is used to initiate a file-transfer operation. Unlike the other Alt-key combinations, Alt-T can only be used when the host system is displaying a DOS prompt. This is because the remote system must send the ZCOPY command line to the host system, which must be at a DOS prompt if it is to process the command line.

USING THE SETUP PROGRAM

Entering a large number of command line parameters each time you bring up a program is cumbersome at best. Also, the PCREMOT2 upgrade provides a number of options that cannot be handled on the command line at all. For these reasons I developed a SETUP program that obviates the need to enter any parameters when executing PCREMOT2. SETUP allows you to set 13 operating parameters which, when saved, are stored as the program defaults in the PCREMOT2.COM file.

SETUP.EXE must be in the same directory as PCREMOT2.COM. (Since many programs have a file called SETUP, make sure one doesn't already exist.) When you enter SETUP, the screen shown in Figure 1 will appear, and as each of the numbered lines is changed, the display will be correspondingly updated. When each parameter is as you wish it, select option 14 to save the new configuration.

Many of the selections only toggle or enable the mode. For example, host/remote mode, desnow, null-modem, smile, and tone/pulse dial automatically change when you select the line number. Selecting the communications speed line brings up a numbered list of choices for the modem baud rate. Similarly, the COM port selection presents you with a choice of the four possible COM ports. If you select COM port 3 or 4, additional menus request COM port address and interrupt number; if you're uncertain of this information, just select the defaults. Menu items 7 through 10 let you select a new key to use with Alt to activate that particular PCREMOT2 capability.

The password (option 11) is displayed as a series of asterisks (*), one for each character in the password. You can change the default password, PC Magazine, to any word or phrase up to 20 characters in length. When you enter a new password, the characters are echoed on-screen so you can verify that you entered the new password correctly. It can be entered in upper- or lowercase characters; PCREMOT2 automatically converts all passwords to uppercase. Option 12 allows you to enter any setup string (up to 30 characters) that your modem may require.

TRANSFERRING FILES

PCREMOT2 uses ZCOPY (which has an excellent error-checking file-transfer protocol) to send files to or from the host computer. For this reason, ZCOPY must be in a directory listed on your PATH.

ZCOPY must also be on both the host and remote computer. If it isn't on both, the transfer will abort after ZCOPY times out (approximately 10 seconds).

When you initiate a file transfer from the remote computer, the keystrokes required to tell ZCOPY the filename, where it is, and where it's going, are sent to the host as a DOS command line. Therefore, the host computer must be at a DOS prompt when the Alt-T sequence is initiated. On the remote computer, PCREMOT2 shells to DOS and executes ZCOPY. Note that the necessary ZCOPY command line parameters are created by PCREMOT2; it is not necessary for you to learn any ZCOPY syntax.

Pressing Alt-T on the remote keyboard prompts you to enter U to upload from the remote computer to the host or D to download from the host to the remote computer. After this selection, the next prompt requests the name of the file to transfer. The file-transfer prompts are extremely explicit. If you choose to Upload a file, for example, you will get the prompt: "UPLOAD REQUESTED. Enter the full pathname of the file(s) on the remote system that you want to upload to the host system:". The Download prompt is similar. Although entering the drive and path are not always necessary; if PCREMOT2 cannot find the file to transfer, the transfer will abort.

The DOS * and ? wildcards are supported when entering the filename to transfer. Note that although it is best to use full *drive:\path\filename* specifications when transferring files, the length of the entire string cannot exceed 42 characters. (PCREMOT2 automatically puts in an Enter after the 42nd character.)

The next prompt is for the location in which to store the transferred file(s). If this is left blank, the transferred file will automatically be placed in the current directory of the receiving computer. If supplied, the destination must be a valid directory (either subdirectory or root directory) on the receiving machine. ZCOPY will not create a new directory, and it does not allow you to rename a file at the same time you transfer it. ZCOPY will query you whether to overwrite an existing file if it detects a same-named file in the destination directory.

If you wish to abort the file transfer before the actual transfer takes place, press the Esc key at any time to terminate the process and return to the remote computer. If you wish to abort a transfer in midstream, simply press the Break key.

Note: Be sure to test all applications you plan to run remotely to ensure they work properly. *Brief*, for example, appears to lock the host computer; however, *Brief* uses video page 1 to display text onscreen. PCREMOT2 displays only text from video page 0. The *Brief* manual uses -p in the command line to disable use of video page 1 and PCREMOT2 works normally. A complete run-through of the program is described in the sidebar, "A Sample Session with PCREMOT2." If a program has both a text and a graphics mode, be sure it is set for text mode or you'll get garbage on the remote screen.

PRINTING ON A REMOTE PRINTER

PCREMOT2 itself does not support printing on a remote printer while executing a program on the host. However, by combining it with PRN2FILE.COM, another *PC Magazine* utility (see the December 22, 1987, issue), you can achieve the same end result. PRN2FILE will capture the printer output of a program run on the host computer, storing it in a file. You can then use PCREMOT2 to transfer the file to your remote machine and use the DOS COPY command to print the file on your printer.

For example, while PCREMOT2 is active, execute the command

```
PRN2FILE TL0191.OUT
```

on the host computer to put all printer output into a file named TL0191.OUT. Run the application that generates printer output on the host computer. Then simply enter PRN2FILE to close the output file TL0191.OUT on the host computer. Use the Alt-T command on the remote computer to begin the file transfer from the host to the remote computer. When prompted for the filename to transfer, enter TL0191.OUT to transfer the printer output file to the remote computer.

After the transfer is complete use the Alt-S command to shell to DOS and enter the command

```
COPY TL0191.OUT LPT1:
```

to transfer the file to the printer. Note, however, that if the application program generates special printer control codes, you must have the same type of printer at the remote site: Being set up for a laser printer at work and a dot matrix at home will produce unexpected results. The obvious solution in such a case is to configure the application on the host computer to use the same type of printer that you have at the remote site.

HOW PCREMOT2 WORKS

After the modem carrier signals have connected, the remote computer sends a burst of 30 carriage return codes each second until it receives an alphanumeric character, which indicates the start of the "Enter password:" message. The host computer uses the carriage return codes to synchronize the speed. If 5 out of 10 characters are carriage returns, then the host is operating at the correct speed and PCREMOT2 synchronizes the host and remote systems.

If the phone line is noisy enough to corrupt more than 5 characters, it is best not to synchronize. Also, if the speeds are not correct, this prevents the strange occurrence of one CR being read. Actually, you could say that we're combining the process of speed synchronization with the synchronization between the two systems. If more than 5 characters are corrupted, the host assumes something is wrong (either the speed is incorrect or the

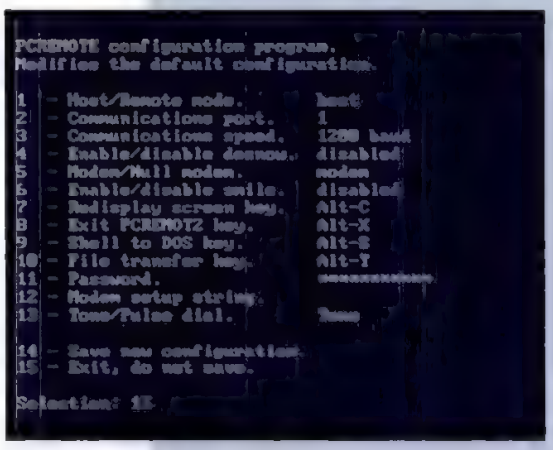

Figure 1: By running SETUP once, you can configure all PCREMOT2 options so that you won't subsequently have to use any command line parameters when bringing up the utility.

line is too noisy) and steps down a notch in speed. If the phone line is very noisy, it is possible that the two computers will be unable to synchronize. If this happens, you must call back with the remote machine set for a lower speed.

The host sends the "Enter password" message after the speed synchronization, and then it verifies that the password is correct. The COM port number is sent to the remote computer ten times and is saved by the remote version of PCREMOT2. This value is subsequently used during file transfer to create the correct COM port number in the ZCOPY command that gets sent to the host. Figure 2 shows the synchronization process.

As part of the upgrade of the original program, PCREMOT2 incorporates a video speed-up routine that effectively compresses the video data that must be sent to the remote computer. The standard 25-row by 80-column display requires 4,000 memory locations for storage; each character displayed requires 2 bytes of information. The first byte in memory is the ASCII character to be displayed, and the second is the attribute of the character. In the host computer, 16 bytes of data are read from the video RAM and compared with a copy of video data maintained by PCREMOT2. If any data in the block doesn't match, the TRANSFER_BLOCK routine is called to format and send the block to the remote computer.

The TRANSFER_BLOCK routine sends a sync byte to the remote computer, followed by the block number for the video data, and then the video data. If all 16 bytes of video data are the same, only 1 byte of video data is sent, otherwise all 16 bytes are sent. The sync byte indicates the data being sent is video data, that it is character or attribute data, and whether all the data in the block is the same. Bit 0 of the sync byte is set to indicate the data is attribute data and reset to indicate character data. Bit 1 is set to indicate all 16 bytes of video data are the same, and it is reset to indicate the 16 bytes of video data are different. Bits 2 through 7 are set to indicate this is video sync byte.

For example, if 16 bytes of video text data on line 1 of the screen contain

```
"C:\>                    ",
```

the data sent to the remote computer is FCh 00h 43h 3Ah 5Ch 3Eh 20h 20h 20h 20h 20h 20h 20h 20h 20h 20h 20h 20h 20h. If the 16 bytes of video attribute data on line 1 of the screen all contain 07h, white on black screen, the data sent to the remote computer is FFh 00h 07h.

If the rest of the screen is blank in the example above, the block with the DOS prompt is the only block that needs to transmit all 16 bytes of video data. The original version of PCREMOTE had to send all the video data, 4,500 bytes of information, to the remote computer. In PCREMOT2, only 3 bytes are sent to the remote when all 16 bytes are the same, instead of 18 bytes. Thus, for the same blank screen (only the DOS prompt displayed) PCREMOT2 needs to send only 765 bytes to the remote computer. Even on an average text screen, in which all the character attributes are the same, only 2,625 bytes are sent to the remote computer. The effective transfer speed is improved two to six times.

The shell-to-DOS function is accomplished with DOS function call 4Bh. This EXEC function allows PCREMOT2 to load and execute COMMAND.COM. Before the DOS function call is executed, the environment is modified to add "DOS SHELL -" to the PROMPT= parameter of the environment. The modified prompt reminds you that you are shelled to DOS and PCREMOT2 is still running.

When the DOS function is called, DS:DX points to the string defined by the COMSPEC= environment variable—normally, the complete pathname of COMMAND.COM. A second copy of COMMAND.COM is loaded and executed. Registers ES:BX point to a parameter block containing the segment address of the environment. The second parameter in the parameter block points to a

A SAMPLE SESSION WITH PCREMOT2

by Kevin Sims

The following is a step-by-step guide to using PCREMOT2.

ON THE HOST COMPUTER:

- Run SETUP, configure for host mode, and verify that the modem COM port and baud rate are set correctly. Make sure you save the configuration (SETUP option 14). The next time you run PCREMOT2 there will be no need to reconfigure.
- Verify that PCREMOT2 and ZCOPY are stored in a directory listed on the host computer's PATH. (Type PATH to see the current PATH. If the directory containing the two programs is not on your PATH, modify the PATH command in your AUTOEXEC.BAT or move the programs to one of the directories on the PATH.)
- Execute PCREMOT2. The program will now be resident on the host. If desired, the host monitor screen can be turned off to prevent burn-in over long periods of inactivity.

ON THE REMOTE COMPUTER:

- Run SETUP, configure for manned mode, and verify that the modem COM port and baud rate are set correctly.
- When prompted, enter the phone number of the office (host) computer.
- After the modems connect, the host sends the "Enter password:" prompt to the remote computer.
- Enter the password. (The default is "PC Magazine".) Any data that now appears on the host computer's screen will be displayed on the remote screen, as well.
- Now you should experiment with PCREMOT2. If you enter DIR, for example, you'll find that scrolling appears a little strange at first.
- Start a text application, such as a word processor or a utility program.
- With the application still active, press Alt-X and exit PCREMOT2. The modems will hang up and the call will be terminated.
- Execute PCREMOT2 and dial back into the host. The application will still be on-screen, executing normally. (Thus, you can start a program that has a long execution time, hang up the phone, and dial back later to see whether the program has finished its task.)
- Terminate the application or shell out from it so that you see the host's DOS prompt on the remote screen. Press Alt-T and follow the very explicit prompts to transfer a file or two between machines.
- When you're finished, press Alt-X and exit PCREMOT2. ■

DOWNLOADING UTILITIES

The programs published in *PC Magazine* are available by modem from PC MagNet, our on-line service.

To find the phone number nearest you, dial 800-346-3247 using your modem. When the modem connects, press Enter. At the HOST NAME prompt, enter PHONES. Follow the menus and make a note of the number closest to you. Or you can call 800-635-6225 and follow the instructions and note the number.

Set your communications software to 300, 1,200, or 2,400 bits per second, 7 data bits, even parity, 1 stop bit, and full duplex.

Dial the local number. When you connect, type Ctrl-C. At the HOST NAME prompt, type CIS. At the USER ID prompt, type 177000,5000. At the PASSWORD prompt, type PC*MAGNET. At the ENTER AGREEMENT NUMBER prompt, type Z11D9200.

Register your name and enter your MasterCard, Visa, or American Express card number. (If you'd like to have your company billed instead, call CompuServe at 800-848-8990.)

Your personal user ID and password will be displayed at the end of the registration process. Record them for logging on over the next few days; a new password will arrive in the mail within ten days to confirm your subscription.

There are no up-front subscription charges: you pay only for the time you spend on-line. CompuServe members can join by entering GO PCMAG at any CompuServe "!" prompt. CompuServe Customer Service can be reached at 800-848-8990. Outside the United States, call 614-457-8650.

PC MagNet costs $12.80 an hour for 1,200- or 2,400-bps service, or $6.30 an hour for 300-bps service. Billing is based on 1-minute increments.

Photocopy this page. Trim and hole-punch the copy and add it to your manual.

PCREMOT2 Command

Terry Lahman and Kevin Sims January 28, 1992 (Utilities)

DOS Commands

Purpose: Allows the remote (home) PC to control the keyboard and monitor the screen of the host (office) computer, via modems or a null-modem cable. Only text-mode programs can be run on the host, but two-way file-transfer capabilities are provided through a modified version of ZCOPY.COM (Utilities, February 28, 1989). Includes a SETUP program that stores all configuration parameters in PCREMOT2.COM.

Format: **PCREMOT2 [/M] [/x] [/Bx] [/D] [/S] [/N] [/U] [/?]**

Remarks: Entered with default parameters, PCREMOT2 becomes an 8K TSR on the host (controlled) computer, using COM 1, 1,200 bits per second, no CGA desnowing, and a default password of "PC Magazine". The /M parameter executes the program on the remote (home) machine, and /*x* accepts values of 1 through 4 for the COM port assignment. (If used, /3 or /4 must not share an interrupt with other devices.) Baud rates are: /B1 (1,200); /B2 (2,400); /B3 (4,800) or /B4 (9,600) bps. Used with a modem connection (the remote unit prompts for and then dials the number), the host will automatically reduce speed to match that of the remote machine.

The /D parameter should only be used if necessary to eliminate snow on older CGA hosts, and the /S parameter displays an ASCII 2 character to indicate that PCREMOT2 is active. For null-modem cable connections, the /N parameter must be specified on both machines, as must a common /B# speed. The /U parameter installs the TSR and the /? provides a syntax help screen.

The SETUP program provides for permanent (updatable) configuration of all parameters, change of password (up to 20 characters), entry of special modem-initialization strings (up to 30 characters), and change of the default Alt-key combinations. Alt-C retransmits the host screen to overcome phone-line noise; Alt-S shells the remote unit to DOS; Alt-X exits the program.

Alt-T initiates file transfers, which can only be done when the host is displaying the DOS prompt and ZCOPY.COM is on its PATH. Full prompts are provided for filename(s) (DOS wildcards are supported) and for source and destination file paths. Files cannot be renamed during transfer. Applications in graphics mode (including Windows) are not supported. Previous PCREMOTE versions must be updated on both host and remote machines.

command line passed to the program being executed. In the case of shell-to-DOS, this pointer is empty. The last two parameters in the block point to file control blocks (FCB). In this case PCREMOT2's file control blocks are used.

In order to perform a file transfer, PCREMOT2 creates a ZCOPY command that contains the filename to transfer and the COM port to use for the transfer. The same DOS function call, 4Bh, is used to execute a second copy of COMMAND.COM. In this case, however, the pointer in the parameter block is set to point to command line parameters that contain a /c and the ZCOPY command line. The /c parameter passed to COMMAND.COM informs COMMAND .COM to execute the program in the command line and then return to the calling program, PCREMOT2.

The results of ZCOPY are ignored on the remote computer and control is returned to PCREMOT2. PCREMOT2 displays the results when the screen is updated by the host computer.

The NULL_MODEM flag indicates to the program that the two computers are connected via a null-modem cable. When the flag is set, PCREMOT2 bypasses the RESET_MODEM routine. The CHECK_CARRIER routine is also bypassed, as it is assumed that the host computer is already connected with a null-modem cable and so does not need to wait for a modem carrier signal. The remote side of PCREMOT2 does not ask for a phone number to dial and instead jumps directly to establishing the connection with the host computer.

The decision to use an external program to conduct the file transfer meant that PCREMOT2 had to be prevented from interfering with the transfer. PCREMOT2 checks all DOS calls for a change to the serial port interrupt vector. If it encounters a change—that is, if another program changes the interrupt vector, PCREMOT2 sets a SLEEP_FLAG and gracefully goes to sleep.

Thus, when ZCOPY takes control of the serial port, PCREMOT2 goes to sleep. At each timer tick, when the host side of PCREMOT2 would normally check for a change in video data and process incoming keystroke data, PCREMOT2 waits patiently until it's time to wake up.

ZCOPY returns the serial port interrupt vector to its original value before exiting. PCREMOT2 monitors anything changing the interrupt vector and if the new vector is the PCREMOT2 code segment, PCREMOT2 wakes up by reinitializing the serial port and clearing the input and output buffers. An Alt-C is sent to the host to cause the entire screen to be updated. The SLEEP_FLAG is reset, and normal operations are resumed.

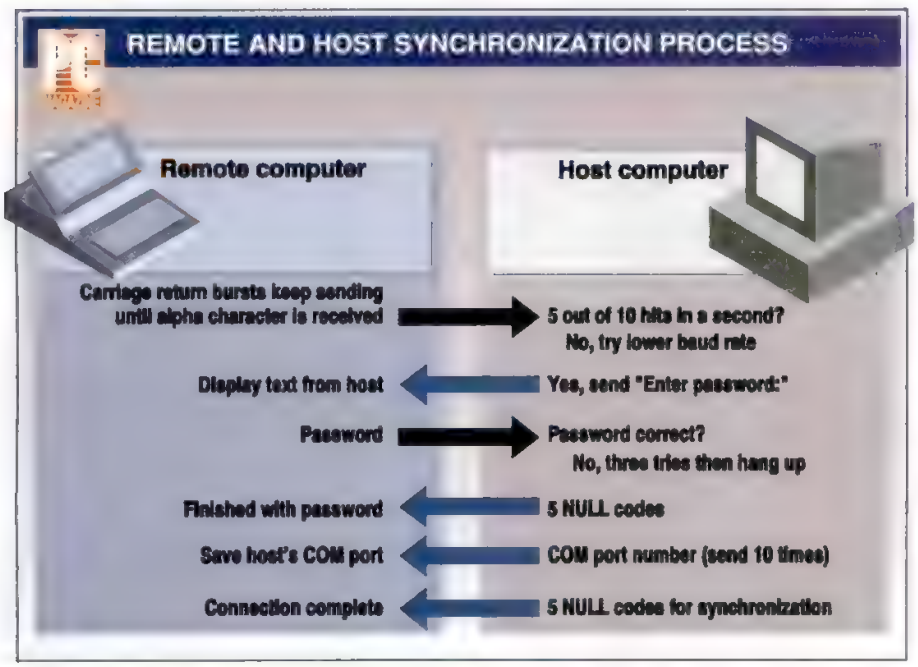

Figure 2: The host makes use of a burst of carriage returns from the remote computer to achieve speed synchronization.

ZCOPY MODIFICATIONS

ZCOPY was originally written to provide file transfer between computers with incompatible disk formats. The design envisaged a laptop computer with a 3.5-inch disk drive and a desktop computer with a 5.25-inch disk drive connected via a null-modem cable, for example. During synchronization, ZCOPY would search and find the fastest baud rate that both computers could support.

A new command line parameter was added to ZCOPY to indicate that PCREMOT2 initiated the file transfer. This new command line parameter causes ZCOPY to modify some of its timing routines so as to support the delays necessary during modem communication. The new parameter proved critical in supporting the delays during line turnaround using half-duplex 9,600-bps modems; without it, ZCOPY would time out and issue a false error. For the rest, PCREMOT2 creates the ZCOPY command line automatically so the user doesn't need to learn the ZCOPY command line parameters.

Other modifications to ZCOPY included support for the lower baud rates of 2,400 and 1,200 bps. Support for COM ports 3 and 4 was also added. The DTR and RTS modem control signals had to be set to prevent the modem from hanging up the connection while ZCOPY was executing, but since these signals were not used by ZCOPY originally, the change had no impact on ZCOPY.

ZCOPY, Version 1.3, which is included with PCREMOT2 on PC MagNet, contains the changes for use with PCREMOT2. The auto-speed search capability in ZCOPY is disabled during use with PCREMOT2. All of ZCOPY's other capabilities remain intact. The ZCOPY command line parameters now support /R to indicate PCREMOT2 has activated ZCOPY. COM3, COM4, and the baud rate parameter now includes /7 and /8 for 2,400 and 1,200 bps, respectively.

It's nice when separately conceived *PC Magazine* utilities work together so serendipitously as do PCREMOT2 and ZCOPY. Together, they give you the control and communications facilities of a number of commercial packages. And if you can make full use of your office machine from your own den, why commute? ■

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by
Andrew Schulman

Lab Notes

Undocumented Functions in Windows, Part 1

If you count the documented and undocumented function calls available to the DOS programmer, you'll come up with a few hundred at most. By contrast, the Windows application program interface (API) is enormous. The functions documented in the Windows Software Development Kit (SDK) alone total almost 600, and if you add the Windows Device Driver Development Kit (DDK), the Multimedia Development Kit (MDK), and Microsoft Windows for Pen Computing, you end up with about 1,200 functions.

Does Windows really need another 250 *undocumented* functions? Yes, and in this and the next Lab Notes column, I'll show you how to find and use some of the more popular ones. A large number are exploited by commercial applications (including Microsoft's); and some critical, yet only recently documented functions are used *by every single Windows application.*

In this installment, I'll approach undocumented Windows functions from within the context of dynamic linking. I'll also discuss the extent to which Microsoft has been willing to unveil some of its secrets as part of its "Open Tools" strategy. Together, we'll examine in detail how one major commercial Windows application uses a few of these undocumented interfaces: GetHeapSpaces, the Get/SetSelectorBase/Limit family of functions, and hard-wired selectors such as __0000H.

THE BEST LAID PLANS. . .

One of Microsoft Windows' key design goals was to be more orderly than DOS. DOS has frequently been criticized as a "house of cards," with memory-resident (TSR) programs, device drivers, disk caches, memory managers, DOS extenders, networks, and multitasking environments (such as Windows itself) all competing for control of the machine. On paper, Windows looks a lot saner. It provides a wide-ranging and seemingly all-inclusive collection of services—such as protected mode, multitasking, dynamic linking, and graphics—that plain-vanilla DOS doesn't. Often, Windows lets the software developer concentrate on making his program do what it is supposed to do rather than on the underhanded shenanigans—including the use of undocumented system functions—that DOS requires for creating a great PC application.

- Despite its orderly, open structure, Windows relies on a host of undocumented functions you need to know about to write your applications.

For example, since Windows 3.0 runs applications in protected mode, you no longer have to worry about expanded memory, overlays, or other methods needed to shoehorn your software into 640K. As with any other protected-mode DOS extender (which is largely what Windows is), the 640K limit has been removed, taking with it a whole class of DOS programming problems.

Again, if you want to write a robust TSR, you simply must make use of undocumented DOS functions. In the multitasking Windows environment, however, all applications are *automatically* memory-resident, so the issue of writing TSRs disappears. (This applies only to Windows applications; if you want to write DOS TSRs that behave properly under Windows, you actually now have a whole additional set of issues to worry about.) Moreover, dynamic linking in Windows largely (though by no means entirely) eliminates the need for programs to hook interrupts in order to provide services to other programs.

The most obvious contrast between the orderliness of Windows and the messiness of DOS relates to graphics. DOS itself doesn't provide services for writing graphical (or even full-screen character-mode) applications, such as a spreadsheet, word processor, or CAD program. Further, the ROM BIOS video services that do exist are just too slow to be of any use. Consequently, most major PC commercial applications write directly to video memory, program the video controller, and generally interact in various low-level ways with the video hardware. Windows, on the other hand, makes such programming tricks unnecessary—indeed, it pretty much forbids them. Windows provides instead a relatively device-independent collection of graphics functions, with moderately acceptable performance, which Windows applications call in a well-behaved, "polite" manner.

Even the idea of "undocumented Windows," then, is really rather alarming. Using undocumented functions is exactly the sort of problem Windows was supposed to eliminate. Making use of functions that Microsoft has implemented but not documented fits DOS's free-wheeling style perfectly, but it seems to contradict Windows' entire spirit and purpose.

In many ways, of course, Windows' more extensive and capable API *has* made DOS-style low-level tricks unnecessary.

What has happened, however, is that in solving many old problems, Windows has introduced a number of new complications. Perhaps this should not be surprising: To provide so much more functionality, Windows' API had to be that much richer than that of character-mode DOS. That, in turn, introduces much more complexity, which inevitably brings with it a number of entirely new programming problems.

One such problem is that while Windows applications run in protected mode and can therefore enjoy multi-megabytes of memory, real-mode DOS has not gone away. Nor is it likely to. Many Windows programs need access to device drivers, TSRs, network drivers, absolute memory locations, and even undocumented DOS functions and data structures. Extensive as it is, the Windows API fails to provide adequate functionality for communicating with real mode from within a protected-mode Windows application. There are plenty of *undocumented* Windows functions, however, that supply this needed functionality.

To provide another example, instead of the asynchronous interrupts that bedevil many DOS applications, events in Windows arrive in the form of properly behaved messages. This is a benefit to non-preemptive multitasking. Indeed, the requirement that a Windows application explicitly *ask* for its next message is what makes Windows multitasking non-preemptive.

Rather than hook INT 8 to get timer events, for instance, a Windows application uses the documented CreateTimer() API call to ask politely for timer messages. Even such timer messages present themselves synchronously, arriving only when the application asks for one by calling the GetMessage() function. Well regulated though it may be, however, this is not the behavior that many applications *need* from a timer—or from other message sources, for that matter. Often an application needs to know about something as soon as it happens, even if it's in the middle of doing something else. Again, the solution is to use undocumented Windows API functions.

BEYOND THE API

Undocumented Windows API functions, messages, and data structures provide only part of the answer to the programming problems that Windows presents. Other solutions are found in

- The DOS Protected Mode Interface (DPMI).
- The Windows Device Driver Kit (DDK), in particular Enhanced mode virtual device drivers (VxDs, or .386 files).
- The "Open Tools" materials provided by Microsoft to independent software vendors (ISVs).
- The ToolHelp dynamic link library (to be made available in Windows 3.1, but which will be backward-compatible with Windows 3.0).

From this list you can see that Windows comprises much more than the functions described in the WINDOWS.H header file that comes with the SDK and with SDK replacements such as Borland C++. WINDOWS.H does not come close to defining the extent of the Windows programming universe. Moreover, the interfaces listed above are of much wider interest than you might at first suspect.

For example, the Microsoft Windows Device Driver Kit (DDK) should attract the attention of more than just the people who are writing Windows device drivers. The DDK, as it happens, is the *only* place where Microsoft documents the INT 2Fh interface that Windows provides to applications running in the Enhanced mode DOS box. Since this service is provided to legions of DOS applications, the INT 2Fh interface is possibly of much wider interest than the Windows API itself, which is directly accessible only to Windows applications and not to DOS applications running under Windows.

Likewise, Enhanced mode "virtual device drivers" or VxDs (.386 files) are often really not device drivers at all. VxDs are the most powerful Windows applications you can write. When a task looks impossible to accomplish in Windows, carrying it out in a tiny VxD is often trivially easy. Some programmers have even come to regard VxDs and the DDK as the "real" Windows API, looking down on the higher-level functions documented in the SDK as mere window dressing, so to speak. In any case, VxD programming will probably become even more important in DOS 6.0.

Although Windows 3.0 certainly raises a number of entirely new problems, not every situation in which a programmer might use an undocumented Windows function is altogether new. For example, just as DOS support for writing debuggers was until recently completely undocumented (it is still incorrectly documented by Microsoft), existing Windows debuggers, such as Turbo Debugger for Windows (TDW), MultiScope, and Microsoft's own CodeView for Windows, all rely heavily on undocumented functions. Microsoft's "Open Tools" strategy (which I'll discuss later), makes a genuine effort to document at least some of the key Windows interfaces needed to write debuggers and other Windows development tools. Since the strategy is apparently aimed at only a select audience, however, and the documentation is in any case incomplete, Windows debuggers, "spy" programs, memory browsers, and the like will probably continue using undocumented Windows functions for some time to come.

DYNAMIC LINKING AIDS SNOOPING

How do you go about finding these undocumented functions? Ironically, you do it by using the very feature that makes Windows services better regulated, better documented, and quite simply less ad hoc than DOS services; namely, dynamic linking. While the DOS API uses interrupt vectors (whose ultimate expression is the TSR program), the Windows API uses dynamic linking.

Windows is not, as is frequently believed, made up of components such as the Program Manager, Control Panel, and Task Manager. These are no more the essentials of Windows than COMMAND .COM is truly part of DOS. As replacements such as *The Norton Desktop for Windows (NDW)* prove, and as can be seen by even a cursory examination of the SHELL= statement in the SYSTEM .INI configuration file, these various managers are all dispensable.

Rather, Windows is made up of DLLs (dynamic link libraries). In Version 3.0 and later, three separate DLLs provide the core of the Windows API:

- KERNEL: This provides system services, such as memory management, task management, and so on. There are three different versions of this module: KERNEL.EXE (for the absurd Windows Real mode that will disappear in Windows 3.1); KRNL286.EXE (for 286 machines or Standard mode); and KRNL386 .EXE (for 386 Enhanced mode).
- GDI: This supplies Graphical Device Interface services. It works with a DISPLAY device driver, such as VGA.DRV, to display text, rectangles, and so forth.
- USER: This DLL provides user inter-

face services, such as creating windows, sending messages, and the like.

Of course, there are many other DLLs whose exported functions go into the Windows API. Some of them, such as WIN87EM.DLL, COMMDLG.DLL, and TOOLHELP.DLL, even carry DLL filename extensions. Others, such as SYSTEM.DRV and KEYBOARD.DRV, are Windows device drivers. But device drivers in Windows are simply DLLs under another name. In Windows 3.1 and in the Multimedia Extensions for Windows, the Control Panel is extensible via *.CPL files; these, too, are nothing more than DLLs. Even Windows *.FON font files are simply DLLs that export discardable, shareable, read-only data (resources) rather than code. Thus, despite the very confusing fact that a single type of file goes under such a welter of different guises (.EXE, .DLL, .DRV, .CPL, .FON, and so on), Windows is in fact made up of DLLs.

In theory, libraries (DLLs) *export* functions, and programs *import* these functions: That's what dynamic linking is. But there is a curious, upside-down quality to Windows that frequently turns this neat theoretical division of labor on its head. In addition to importing functions, Windows programs can also *export* functions, known as *callbacks*, which are used by Windows itself. Here, the program itself is treated as if it, too, were a library. Similarly, DLLs can *import* functions, using the services of other DLLs.

The result is that the components of Windows itself (such as USER.EXE) and Windows programs (such as MYPROG .EXE) look almost the same. Given that fact, it is not surprising that an application can also provide its own DLLs, which appear indistinguishable from the DLLs that come "built into" Windows. Another way of saying this is that the built-in DLLs aren't really built in, apart from one important property: their special knowledge of undocumented functions and data structures.

We will see in a minute that we can find the name of every function that a DLL exports simply by inspection. We can then see if a prototype for this function appears in WINDOWS.H. That gives us a rough idea of what's undocumented. More important, from a practical viewpoint, we can also find the name of every function that a Windows program imports. By then comparing this list against the list of documented functions, we can determine which programs use which undocumented functions. That gives us a rough idea of which undocumented functions are important and genuinely useful.

The structure of segmented executable files (a superset of the DOS .EXE format that is shared by both DLLs and Windows programs) makes it trivial, almost a joy, to do this sort of exploration. Actual disassembly of code becomes important at a much later stage than it would in DOS. Ironically, it is the very fact that Windows is so orderly about the way that services are provided and used that makes it easy for us to see that maybe the Windows world isn't quite so orderly and well regulated, after all.

Like it or not, commercial application programming in Windows exhibits most of the chaos and unruliness that one associates with DOS programming. This is not terribly surprising, considering that, for the foreseeable future (promises of the whiz-bang 8MB NT—New Technology—notwithstanding), Windows is an extension of, not a replacement for DOS. The widespread use of undocumented functions in Windows applications should thus be seen not as a deplorable fall from grace, but as a healthy sign of vitality. As the economist Joseph Schumpeter noted in a somewhat different context, "If the system was perfect, it wouldn't work." Bless this mess!

EXPLORING NDW

We've noted that because of the way Windows works, Windows .EXE files are more structured than DOS .EXE (not to mention .COM) files. Without running the program or even disassembling it, Windows dynamic linking makes it easy to see what API calls a Windows application uses. Let's now apply this knowledge to do a bit of digging into *The Norton Desktop for Windows*. Although the first release of *NDW* had some odd behavior, it is easily the finest set of Windows utilities available and, at least in Windows 3.0, is a must-have replacement for Windows' own Program Manager.

NDW is a collection of programs, including NDW.EXE itself, SIW.EXE (System Information for Windows), SLEEPER.EXE (a screen saver), NDDW .EXE (Norton Disk Doctor), and so on. It also includes several dynamic link libraries, such as NWIN.DLL, NDWDLL.DLL, and NDLL.DLL. It is typical of commercial Windows applications that, in addition to the KERNEL, GDI, and USER DLLs that come bundled with Windows, they also provide DLLs of their own. Of the many executable files that come with *NDW*, let's arbitrarily select NBWIN.EXE (*The Norton Backup for Windows*) to examine in detail.

Like all Windows programs, DLLs, and device drivers, NBWIN.EXE uses Microsoft's segmented-executable (or "new executable," or, simply, NE) file format. A wide range of utilities understand this file format, and such tools are essential for anyone interested in productive spelunking in Windows. We might, for example, make our examination using the TDUMP utility that comes with Borland C++. If we do, amidst many other details about the file, we will find a list of the "modules" (DLLs and device drivers) whose services NBWIN directly uses. Figure 1 shows part of the output when we run TDUMP on NBWIN. (Note that none of the tools I'll discuss here are themselves Windows programs. Moreover, since they perform a *static* analysis of executable files, Windows does not even need to be running in order to use them. On the other hand, these utilities can of course be run in a DOS box under Windows.)

TDUMP can also tell us exactly which Windows API functions NBWIN (or any other Windows program, DLL, or device driver) uses. Microsoft's EXEHDR utility, which is included with Microsoft C, provides the same information. The snooping possibilities within a dynamic linking environment such as Windows are fascinating. In DOS it is comparatively difficult to learn which software interrupts and functions a program uses. Here, by contrast, simply by seeing which Windows API functions a program uses (or at

NBWIN'S WINDOWS MODULES

```
C:\BORLANDC\BIN>tdump \ndw\nbwin.exe
...
Module Reference Table
  Module  1: NDWDLL
  Module  2: NDLL
  Module  3: NBWRES
  Module  4: NBWFD
  Module  5: NWIN
  Module  6: KERNEL
  Module  7: GDI
  Module  8: USER
  Module  9: KEYBOARD
```

Figure 1: After entering the command line shown, Borland's TDUMP utility reports the Windows modules referenced by *The Norton Backup for Windows*.

least references, which is not quite the same thing), we can do a high-level disassembly, without disassembling a single line of code.

Unfortunately, the form in which TDUMP and EXEHDR present their information is not as useful as it might be. A portion of the EXEHDR output is shown in Figure 2. In the module.ordinal format (for example, KERNEL.169, USER.33, or GDI.35) the ordinal number is simply an identifier for a function exported by a given DLL. Windows functions also have real names, which appear in DLLs as NULL-terminated ASCII (ASCIIZ) strings such as GETFREESPACE or STRETCHBLT. Nevertheless, it makes sense for programs or other DLLs that use these services to reference them in the shorter module.ordinal form.

The raw data dumped out when you run a utility such as TDUMP or EXEHDR on a Windows program like NBWIN.EXE can be made useful by finding the ASCIIZ names that correspond to each module.ordinal import reference. We find these simply by running TDUMP or EXEHDR again, *this time on the DLLs that export the functions that the program imports.*

To illustrate the process, you can see in Figure 2 that one section of NBWIN .EXE uses some functions from the Windows USER module. If we now examine USER.EXE with the EXEHDR utility, we see a list of every function that USER exports. A small portion of this list (which, unfortunately, is not sorted in any way) is shown in Figure 3.

In all, about 400 functions are listed in USER.EXE alone. Not surprisingly, if you examine the list you'll find a good number of functions that—judging simply from their names—sound useful, but which are not listed either in the *Windows Programmer's Reference* or in the WINDOWS.H header file. These are usually, but not always, undocumented functions.

NBWIN'S API FUNCTIONS

```
C:\BIN>exehdr /v \ndw\nbwin.exe
...
    PTR     0333  imp KERNEL.169
    PTR     010b  imp GDI.35
    PTR     0013  imp KERNEL.47
    PTR     00a8  imp USER.33
    PTR     017d  imp KERNEL.51
    PTR     009b  imp USER.36
    PTR     01e2  imp KERNEL.52
    PTR     02b0  imp USER.420
    PTR     00e4  imp GDI.45
    PTR     0089  imp USER.39
    PTR     0133  imp USER.40
```

Figure 2: A portion of the output from Microsoft's EXEHDR utility that displays the Windows API functions used by NBWIN.

This is probably not the most productive angle from which to approach undocumented Windows, however. Rather than embark on an Easter egg hunt—trying to find every function exported from a DLL that doesn't happen to be listed in the *Programmer's Reference* or in WINDOWS.H—it's more important to ferret out the undocumented Windows functions actually used by existing commercial Windows applications. Otherwise, the search for undocumented functions can become more like collecting baseball cards than like software engineering.

Returning to Figure 2, then, you'll see that NBWIN imports USER.40, for example. Looking next at the excerpt of USER exports in Figure 3, you'll observe that ordinal number 40 in the USER module corresponds to the function ENDPAINT. Thus, we now know that NBWIN calls the EndPaint() function. This should hardly be surprising, since it is almost impossible to produce any screen output in Windows without calling this (documented) function. You could carry out this same import/export process for *every* module.ordinal referenced by NBWIN (or by any other Windows program or executable) and produce a complete picture of the Windows services it uses.

While the picture that emerges is extremely interesting, the process of delineating it would be wearisome indeed. That's just the sort of work that computers are good for! What we really need here is a utility that will print out a list of all the Windows API functions that a program uses and silently do all the work of matching up module.ordinal imports with ASCIIZ name exports.

MAPWIN, written by Richard Smith, president of Phar Lap Software, is just such a utility and is available for downloading from PC MagNet. (Downloading instructions are contained in a sidebar to the PCREMOT2 utility printed in this issue's Utilities column.) I might have used this utility earlier, omitting the discussion of EXEHDR and TDUMP, but it's important to understand the process that MAPWIN automates.

Part of what you'll see when you examine NBWIN.EXE with MAPWIN is shown in Figure 4. In all, MAPWIN lists 238 different functions referenced by NBWIN.EXE. As is typical for Windows applications, a little over half the different functions used are in the USER (window manager) module, about a quarter are in the KERNEL (system services) module, and the remaining functions belong to other modules such as GDI (graphics) and KEYBOARD. NBWIN also uses a number of functions from the DLLs that come with *The Norton Desktop*.

Naturally, some functions used by NBWIN are also used by nearly every other Windows application. Functions such as RegisterClass(), CreateWindow(), GetMessage(), and DefWindowProc(), are essentially "boilerplate"—part of the standard litany recited each time a Windows application is created and called by 95 percent of all existing Windows programs. (The other 5 percent are often extremely useful Windows utilities.)

What we're after, however, are the *undocumented* features of Windows NBWIN might be using. That means we must filter out every "standard" call made by NBWIN. By "standard" I mean a function that appears either in the WINDOWS.H header file, in the *Microsoft Windows Programmer's Reference* or in its *Guide to Programming*. (Chapters 14, 15, and 16 of this last reference document several important items that are intended to be used only in assembly language and are therefore not included in the *Programmer's Reference*). There are various ways to filter out all these documented calls; I have found the AWK programming language ideal for writing utilities that perform such text-manipulation chores. In any case, when we filter out the documented calls, we're left with seven items that are referenced by *The Norton Backup for Windows*, but that are listed nowhere in the Windows SDK manuals or header files. They are

```
_ _0040h (KERNEL.193)
GETHEAPSPACES (KERNEL.138)
GETSELECTORBASE (KERNEL.186)
INITAPP (USER.5)
INITTASK (KERNEL.91)
SETSELECTORBASE (KERNEL.187)
WAITEVENT (KERNEL.30)
```

It would seem that we have finally reached our destination: Here are Windows API calls made by a major Windows application, produced by a firm known for producing robust, high-quality software, and we can't find these items anywhere in the SDK.

MICROSOFT'S OPEN TOOLS

Actually, we're not quite there yet. We first need to deal with three specific functions: InitApp(), InitTask(), and WaitEvent(). If you run MAPWIN, you'll see these three functions called from any and every Windows application, because they're part of the standard Windows start-up code!

When writing Windows applications in C or C++, your program's perceived start of execution is at the idiosyncratic WinMain() function rather than at the standard main() function used everywhere else in the C world. This use of WinMain() rather than main() is totally unnecessary, and I regard it as a design flaw of the Windows API. Be that as it may, however, WinMain() is called with four arguments:

```
int PASCAL
 WinMain(HANDLE hInstance,
 HANDLE hPrevInstance,
 LPSTR lpszCmdLine, int nCmdShow)
```

Note the *is called* in the sentence above. *Who* is calling WinMain? In Chapter 19 of his *Programming Windows*, Charles Petzold notes that WinMain() is not the true entry point for your program. Instead, the initial entry point is indicated, just as it is in DOS, with an END statement in an assembly language module. That module is the start-up code, which is provided with your compiler's runtime library. It sets things up for and then calls WinMain().

As Petzold notes, on entry to a Windows program (DLLs operate differently), the CPU registers hold these values:

```
BX   Stack size
CX   Heap size
DI   Instance handle (hIntance)
SI   Previous instance
     (hPrevInstance)
ES   Program segment prefix (PSP)
```

The question is, what happens between here and WinMain()? What happens is that the start-up code provided by the compiler's runtime library calls InitTask(), WaitEvent(), and InitApp(). While the Microsoft SDK does not contain source code for the start-up module, Borland C++ does. Thus, if you have Borland C++, you can learn all about Windows start-up conditions by reading the nicely commented file \BORLANDC\EXAMPLES\STARTUP\C0W.ASM.

The details of these three calls are probably only of interest to those working on a compiler with Windows support or to someone (like me) who has worked on implementing custom versions of the KERNEL and USER modules. But the political strategy behind their treatment is rather interesting.

For years, every single Windows application has contained these three undocumented calls. Yet InitTask(), WaitEvent(), and InitApp() really are not documented anywhere in the SDK. This is bizarre, for since the SDK is really not part of Windows itself, it ought to have no more "privileged" a position than any other application or third-party development tool.

But by *not* documenting the calls needed to take a Windows application from start-up to WinMain(), thereby allowing it actually to run under Windows (talk about a crucial feature!), Microsoft's SDK had for years maintained a near-monopoly on the Windows development-tools market. This is even more annoying because, apart from this little start-up code, the SDK doesn't bring much to the party. True, Windows API functions are often referred to in third-party books as "Kit routines" or "SDK functions." But as I've already noted, Windows' dynamic linking means that these functions are actually part of the DLLs contained in every retail copy of Windows; they are thus definitely *not* part of the SDK. The SDK, in other words, provides remarkably little other than the "secret sauce" of making a Windows program jump through the necessary hoops to get to WinMain().

Eventually, I suspect, someone at Microsoft finally realized that Windows sales were more important than SDK sales. Thus, it would be in Microsoft's own interest for there to be excellent Windows development tools available, even if they did compete with its own SDK and with its own C compiler.

The end result is what Microsoft calls its "Open Tools Strategy." This is an attempt to "level the playing field" in Windows development tools by making key pieces of previously undocumented information available to tools vendors—including such direct competitors with Microsoft C and the SDK as Borland and Zortech/Symantec. While it's not widely distributed, there is an enormous three-ring binder of this material available to independent software vendors (ISVs) who send Internet mail to isv@microsoft.com.

The Open Tools binder provides information on the following previously undocumented topics:

- Windows Application Start-up (how to call WinMain(): the InitApp(), InitTask(), and WaitEvent() functions).
- Windows Prologs and Epilogs (initialization of the DS register for callback functions).
- Windows 80x87 Floating-Point Emulator (a not entirely accurate description of WIN87EM.DLL and OS fixups).
- Self-Loading Windows Applications (the PatchCodeHandle() function used by both *Microsoft Word for Windows* and *Microsoft Excel*. Rather than rely entirely on the normal Windows loader in the

THE USER MODULE'S API FUNCTIONS

```
C:\BIN>exehdr \windows\system\user.exe
...
Library:        USER
Description:    Microsoft Windows User Interface
...
Exports:
ord seg offset name
465  14  03c6  DRAGDETECT exported, shared data
404   8  0296  GETCLASSINFO exported, shared data
175  12  0999  LOADBITMAP exported, shared data
 88  24  22e4  ENDDIALOG exported, shared data
500   1  558e  FARCALLNETDRIVER exported, shared data
272   1  1ac5  ISZOOMED exported, shared data
168   3  20bd  SETCARETBLINKTIME exported, shared data
147  38  015a  SETCLIPBOARDVIEWER exported, shared data
...
 40   1  59cc  ENDPAINT exported, shared data
...
```

Figure 3: A portion of the output from Microsoft's EXEHDR utility. Here, it is displaying Windows API functions provided by the Windows USER module.

WinExec() function, these applications use nonstandard executable file formats and work around bugs in the Windows loader, and so they take care of loading themselves into memory. Open Tools only documents the PatchCodeHandle() function, however, and not the actual proprietary executable-file schemes, such as "compressed relocation records," which are used by *WinWord*).

- Creating Windows-Hosted Debuggers (documentation for functions such as DirectedYield() and SetEventHook()).
- Resource Formats within Executable Files. (The resource formats *outside* executable files remain undocumented by Microsoft.)
- Executable File Format. (Most of this has already been documented in OS/2 1.*x*, which uses exactly the same segmented-executable NE file format as Windows. See Ray Duncan, *Advanced OS/2 Programming*, Appendix D: OS/2 Load Module Format.)
- Object Module Format for Windows. (In particular, the IMPDEF and EXPDEF records that form the link between an application's call to, for example, GetVersion() on the one hand, and module .ordinal pairs such as KERNEL.3 on the other. These .OBJ records are also documented in yet another obscure Microsoft offering, the Microsoft C *Developer's Toolkit Reference*, which can be ordered as Part No. 18161 through normal Microsoft sales channels.)
- Library and Import Library Formats (the structure of a Windows import library as produced by the IMPLIB utility).

Open Tools also helps underline the point that WINDOWS.H and the SDK do not define the full extent of the Windows universe. A further illustration of this point is that some Windows API functions that seem undocumented are actually described in the Windows Device Driver Kit (DDK).

While the program we're examining, NBWIN, does not happen to use any functions that are documented in the DDK, it is crucial to include the DDK in any discussion of undocumented Windows. There is an unfortunate tendency among those who explore undocumented Windows to jump to the conclusion that anything not in WINDOWS.H is therefore undocumented. WINDOWS.H, Petzold's book, and the *Programmer's Reference* do not neatly encompass all of the Windows API; it's much more than that. Anyone interested in undocumented Windows should also become familiar with such obscure but documented aspects of Windows as the DDK, DPMI, and the Open Tools documentation.

Another little-known but excellent source of information on Windows is the Microsoft "Knowledge Base." This contains what are essentially tech-support logs for the SDK and DDK. Do you want to know how to call a Windows DLL from a DOS TSR or how to speed up the TextOut() function? Do you want to know about known problems with the GlobalReAlloc() function or with "huge" contiguous memory? There's an enormous amount of useful information in the "Knowledge Base," which is available both on-line on CompuServe (GO MICROSOFT) and as part of the Microsoft Programmer's Library CD-ROM.

Now, having discussed the InitApp(), InitTask(), and WaitEvent() functions and related issues, we can return to the four genuinely undocumented items in NBWIN:

```
_ _0040h (KERNEL.193)
GETHEAPSPACES (KERNEL.138)
GETSELECTORBASE (KERNEL.186)
SETSELECTORBASE (KERNEL.187)
```

This may not seem like a lot, but remember that we've been looking at only a single program. As we'll see in Part 2 of this article, there are many additional undocumented Windows API functions that are used by key Windows applications, including Microsoft's own applications.

In the remainder of this article, we'll examine these four items in detail. You may wish to note that GetHeapSpaces() was also discussed in Fran Finnegan's Windows column ("Monitoring Free System Resources") in the November 12, 1991, issue of *PC Magazine*, and that I briefly discussed the Get/SetSelectorBase functions in my Lab Notes ("The Programming Challenge of Windows Protected Mode") in our June 25, 1991, issue.

THE SAGA OF FSRs

The undocumented GetHeapSpaces() function (KERNEL.138) is used in determining one of the more visible—and yet confusing—aspects of Windows performance, stability, and capacity: system resources. The percentage of free system resources (FSRs) appears (along with the amount of free memory) in the Program Manager About box. The number is important to Windows users because it determines, at least as much as the amount of free memory, the number of applications that can reasonably be run at the same time. All *Norton Desktop for Windows* applications, including NBWIN, also show the FSR percentage in their About boxes.

Where does this information come from? And what does it really mean? Like Program Manager, *NDW* computes the percentage of FSRs on the basis of the value returned from the undocumented GetHeapSpaces() function:

SAMPLE OUTPUT FROM MAPWIN

```
C:\BIN>mapwin @win30.imp \ndw\nbwin.exe
...
GETPROFILESTRING (KERNEL.58)
GETPROP (USER.25)
GETSELECTORBASE (KERNEL.186)
GETSTOCKOBJECT (GDI.87)
GETSUBMENU (USER.159)
GETSYSCOLOR (USER.180)
GETSYSTEMMENU (USER.156)
GETSYSTEMMETRICS (USER.179)
GETTEMPFILENAME (KERNEL.97)
GETTEXTEXTENT (GDI.91)
GETTEXTMETRICS (GDI.93)
GETTICKCOUNT (USER.13)
GETVERSION (KERNEL.3)
GETWINDOW (USER.262)
GETWINDOWLONG (USER.135)
GETWINDOWRECT (USER.32)
GETWINDOWTEXT (USER.36)
GETWINDOWWORD (USER.133)
GETWINFLAGS (KERNEL.132)
GLOBALADDATOM (USER.268)
GLOBALALLOC (KERNEL.15)
GLOBALCOMPACT (KERNEL.25)
GLOBALDOSALLOC (KERNEL.184)
GLOBALDOSFREE (KERNEL.185)
GLOBALFREE (KERNEL.17)
GLOBALHANDLE (KERNEL.21)
GLOBALLOCK (KERNEL.18)
GLOBALNOTIFY (KERNEL.154)
GLOBALREALLOC (KERNEL.16)
GLOBALUNLOCK (KERNEL.19)
GRAYSTRING (USER.185)
INFLATERECT (USER.78)
INITAPP (USER.5)
INITTASK (KERNEL.91)
INVALIDATERECT (USER.125)
INVERTRECT (USER.82)
ISDIALOGMESSAGE (USER.90)
...
```

Figure 4: The MAPWIN utility, which is available for downloading from PC MagNet, reveals both the documented and undocumented Windows API calls made by Windows programs. The listing above shows part of the output obtained by running MAPWIN on NBWIN.

```
extern DWORD FAR PASCAL
  GetHeapSpaces(HANDLE hModule);
```

The heap spaces of interest are actually those of the window manager (USER) and the Graphical Device Interface (GDI) modules in Windows. Like any other Windows DLL or application, these modules have local 64K heaps from which memory can be allocated with the normal, documented LocalAlloc() function. What makes USER and GDI so special is that these modules are used by all the other modules in the system.

Every window or menu an application creates looks to USER like just another LocalAlloc() from its local heap. Every device context (DC) handle, brush, pen, region, font, or bitmap an application creates looks to GDI like just another LocalAlloc() from *its* local heap. The implications of this are rather alarming. Since all Windows applications share a single 64K heap in USER and a single 64K heap in GDI, the amount of memory remaining in these two heaps is often more important than the amount of total system memory! Even with megabytes of memory available in protected mode, the number of applications that can simultaneously be run—and their stability—is constrained by these two 64K barriers. (In Windows 3.1, menus will be moved out of USER's local heap, partially relieving the system resources problem.)

Why do USER and GDI use LocalAlloc() to allocate system resources for other applications? Why not call GlobalAlloc() and thereby remove the 64K limit? The reason is that it is more efficient for USER and GDI to address resources with 2-byte near pointers than with the 4-byte far pointers necessary for objects created via the GlobalAlloc() function. The Windows designers therefore made a time-versus- space trade-off.

The FSR percentage, then, is simply the smaller of the percentage of USER's or of GDI's local heap that remains free. Given a module handle, the undocumented GetHeapSpaces() function returns an unsigned long (DWORD) that contains the total number of bytes in the module's local heap in its high word, and the number of *free* bytes in its low word. As shown in Figure 5, it is up to the application that calls GetHeapSpaces() to compute percentages and pick the smaller.

Note that GetHeapSpaces() is passed an arbitrary module handle returned from the documented GetModuleHandle() function. Two points are important here. First, all you need is the ASCIIZ name (such as USER or GDI) of a module in order to get this information. This is a good example of the point that Windows makes extensive use of strings rather than magic numbers, which makes it a far more accessible and open system than DOS. Second, GetHeapSpaces() is passed an arbitrary module handle, and so is not limited to use with GDI and USER. Still,

```
GetHeapSpaces(GetModuleHandle
  ("KERNEL"))
```

would make no sense, since KERNEL has no local heap.

As with most undocumented Windows API functions, all you need to use GetHeapSpaces() is a function prototype like that shown in Figure 5. Import libraries such as LIBW.LIB in Microsoft C and IMPORT.LIB in Borland C++ already contain the necessary IMPDEF records, even for undocumented functions. WINDOWS.H, however, does not contain prototypes for undocumented functions (this is pretty much what makes them undocumented!), so you need to supply that yourself.

GetHeapSpaces() is itself implemented in KERNEL using another undocumented function, LocalCountFree(), which returns the number of free bytes in a local heap. GetHeapSpaces() then uses the documented GlobalSize() function to get the total size of the heap.

There is an obvious problem when something as visible to end users as the FSR percentage has to rely on an undocumented function. Microsoft decided not to document the GetHeapSpaces() function, but instead to provide what seemed like equivalent functionality. TOOLHELP.DLL, which is included with Windows 3.1, contains two functions, GDIHeapInfo() and UserHeapInfo(), which provide the same information as does GetHeapSpaces(). TOOLHELP does not come with Windows 3.0, but will work on top of it, nicely demonstrating the power of dynamic linking. An addendum to the SDK license agreement permits you to redistribute TOOLHELP and certain other DLLs along with your application. Thus it seems as if the FSR problem has been solved: Call the documented GDIHeapInfo() and UserHeapInfo() functions rather than the undocumented GetHeapSpaces() function, and ship TOOLHELP.DLL along with your application.

Why might you want to continue using GetHeapSpaces() rather than go with TOOLHELP? Aside from a desire not to change code that already works, one problem is that you might not want to ship an entire DLL along with your product just to show one silly number in your About box. And, once you start shipping a system DLL such as TOOLHELP, your Install program needs to worry about "registration" issues: What if the user already has TOOLHELP in a later version than the one you ship? With DLLs, you can get into a number of nasty version issues. (This is an equally nice demonstration of the downside to dynamic linking.)

In the end, Microsoft settled on the

KERNEL.138 — CODE FRAGMENT

```
/* undocumented Windows call: KERNEL.138 */
extern DWORD FAR PASCAL GetHeapSpaces(WORD hModule);

void heap_info(char *module, WORD *pfree, WORD *ptotal, WORD *ppercent)
{
   DWORD info = GetHeapSpaces(GetModuleHandle(module));
   *pfree = LOWORD(info);
   *ptotal = HIWORD(info);
   *ppercent = (WORD) (((DWORD) *pfree) * 100L) / ((DWORD) *ptotal));
}

// ...

WORD user_free, user_total, user_percent;
WORD gdi_free, gdi_total, gdi_percent;
WORD total_free;

heap_info("USER", &user_free, &user_total, &user_percent);
heap_info("GDI",  &gdi_free,  &gdi_total, &gdi_percent);
total_free = min(user_percent, gdi_percent);
```

Figure 5: This C code fragment illustrates the use of the undocumented GetHeapSpaces().

GETVERSION()

```
WORD vers = GetVersion();
if ((LOBYTE(vers) == 3) && (HIBYTE(vers) == 0)) // 3.0
   use GetHeapSpaces(GetModuleHandle()) method
else // 3.1+
   use GetFreeSystemResources method
```

Figure 6: This pseudocode is an example of how to verify the Windows version number before you call an undocumented function.

following method: Use the undocumented (but hereby quasi-sanctioned) GetHeapSpaces() function in Windows 3.0 and in Windows 3.1 and later use a new, documented, function that will be called GetFreeSystemResources(). An application uses the documented GetVersion() function to determine the Windows version under which it is running; GetVersion() is crucial whenever you are working with undocumented Windows functions. This is illustrated in the pseudocode that is shown in Figure 6. Isn't it amazing how complex it is to show the user the FSR percentage?

THE PROBLEM WITH PROTECTED MODE

All three of the other undocumented items used by NBWIN—__0040h (KERNEL.193), GetSelectorBase (KERNEL.186), and SetSelectorBase (KERNEL.187)—have to do with the fact that Windows applications now run in protected mode. Indeed, like most good Windows applications, NBWIN runs *only* in protected mode. (The idea that "good" Windows applications should be able to run in Real mode was a piece of foolishness put forward in the *Microsoft Windows Guide to Programming*. Thankfully, Real mode won't be in Windows 3.1.) Protected mode means an end to the 640K DOS limitation; NBWIN can use multi-megabytes of memory to read and back up a large number of files efficiently.

However, like any other improvement, protected mode also has a downside. Though less restrictive about the amount of memory it provides, protected mode is more restrictive about everything else. It's a tradeoff that is well worth making, but the result is that some real-mode code simply won't work in protected mode.

If a Windows application needs to access absolute memory locations (for instance, 522h), it can no longer do so by creating pointers such as 0000:0522 out of thin air. In real mode, pointer 0000:0522 addresses absolute memory location 522h. The equivalence between pointers and absolute memory locations is why it's called real mode. That equivalence doesn't hold in protected mode.

Suppose you need to access absolute memory location 522h. In a real-mode program, you might do the following

```
xor bx, bx
mov es, bx              ; es := 0
mov ax, es:[0522h]
```

(It is much better to use the INT 1Eh vector to get the address of the Disk Parameter Table, which is normally stored at 522h; this is for example only.) Alternatively, in C, you might use the code shown in Figure 7.

Inside a protected-mode Windows application this code will cause an Unrecoverable Application Error (UAE). The problem is that the application has dereferenced an invalid pointer. The pointer is invalid because the application merely manufactured the segment (selector) value itself. Even worse, the selector happens to be zero, which always creates a NULL pointer in protected mode.

LOCATE ADDRESS 522H

```
#ifndef MK_FP
#define MK_FP(s,o) \
   ((void far *) (((DWORD) (s) << 16) | (o)))
#endif

unsigned char far *fp;
unsigned char some_byte;

fp = MK_FP(0, 0x522);
some_byte = *fp;
```

Figure 7: This real-mode C code for accessing absolute memory location 522h will cause a UAE (Unrecoverable Application Error) in a Windows program.

To make such code work in *any* protected-mode environment, including Windows, you need a facility that creates protected-mode addresses that "map" the real-mode addresses. The procedure starts by allocating a selector. Then you set its *base address* to the absolute memory location you want to access and its *limit* (the last valid byte offset) to the size you need. It's easiest to put all this inside a function whose job is to map in real-mode far pointers. C pseudocode for such a map_real() function is shown in Figure 8.

To use the map_real() function, a program must pass in the real-mode far pointer and the number of bytes it wants to access. The function returns a protected-mode pointer that should be used instead of the original real-mode pointer. A program can call map_real() during initialization and use the pointer throughout its execution. At some point before terminating, however, the program must use the documented FreeSelector() function to deallocate the allocated selector; Windows will not automatically free it when your program exits.

Turning map_real() into genuine code requires only locating the Windows functions that allocate, set the base and limit of, and free selectors. A selector can be allocated in Windows by using the documented AllocSelector() function; it can be freed with the FreeSelector() function. But how do you set its base and limit? There are numerous ways to do this in Windows, but, unfortunately, none of them is documented by Microsoft.

Perhaps the most complete solution to the problem of accessing real-mode data structures from a protected-mode Windows application is to use the INT 31h services provided by the DOS Protected-Mode Interface (DPMI). Windows provides DPMI Version 0.9 services; the DPMI 0.9 specification (May 15, 1990) is available from Intel as Part No. 240763. (The more extensive DPMI 1.0 specification of March 12, 1991, is also available from Intel as Part No. 240977, but since Windows 3.0 and 3.1 incorporate only DPMI 0.9, the newer specification is less useful to Windows programmers.)

To set the base and limit of an already allocated selector with DPMI, you could

use the Set Segment Base Address `INT 31h AX=7` and Set Segment Limit `INT 31h AX=8` functions. These set the base and limit of the segment descriptor that corresponds to a selector; such segment descriptors are located in the protected-mode Global Descriptor Table (GDT) and Local Descriptor Table (LDT).

A problem with this approach, however, is that Microsoft barely documents the fact that INT 31h DPMI services are available under Windows, and in any case it approves only a small handful of them for use in Windows programs. The two DPMI functions noted above are *not* on the approved list. According to a Microsoft Developer's Note entitled "Windows INT 21h and NetBIOS Support for DPMI," only seven DPMI functions—all related to calling real-mode code—can be used in Windows applications. Other than these, "no DPMI functions are required for Windows applications since the KERNEL provides functions for allocating memory, manipulating descriptors, and locking memory." (A packet of such notes, supposedly "of interest to a relatively small number of Windows SDK users," is available as Microsoft Part No. 050-030-313.)

In a sense, this is true: The Windows KERNEL *does* provide functions for manipulating descriptors, that is, setting and getting their base address and limit. Prototypes for these functions are shown in Figure 9. One major drawback is that these functions are undocumented. Consequently, you're stuck with using either DPMI INT 31h functions—which Intel documents but Microsoft doesn't sanction—or Windows KERNEL functions, which Microsoft doesn't document. What a choice!

```
GET/SETSELECTORBASE/LIMIT

void FAR PASCAL SetSelectorBase(WORD sel, DWORD base);
void FAR PASCAL SetSelectorLimit(WORD sel, DWORD limit);
DWORD FAR PASCAL GetSelectorBase(WORD sel);
DWORD FAR PASCAL GetSelectorLimit(WORD sel);
```

Figure 9: The undocumented Windows KERNEL Get/SetSelectorBase/Limit API functions.

DPMI is certainly not the easiest solution. DPMI programming is sufficiently difficult (or at least unfamiliar) that even many experienced Windows programmers would rather use undocumented functions than use the DPMI. In any case, embedding such calls as `INT 31h AX=7` in your application seems to go against the spirit of Windows programming, especially when there are genuine Windows functions such as SetSelectorBase() seemingly just waiting to be used. Finally, since Windows does at least provide AllocSelector(), it makes sense to stick with Windows, rather than allocating the selector with the Windows API calls and then manipulating it with INT 31h calls. (It should be noted that none of these selector-manipulation calls are likely to be available to 32-bit programs running under Windows NT.)

```
MAP_REAL()

void far *map_real(void far *rmode_ptr, unsigned long nbytes)
{
   WORD sel;

   // allocate a selector
   if ((sel = get_a_selector(READWRITE_DATA)) == 0)
      return 0;   // no available selectors

   // set its absolute base address; base=(seg*16)+ofs
   set_selector_base(sel,
      (((DWORD) FP_SEG(rmode_ptr)) << 4) + FP_OFF(rmode_ptr));

   // set its limit; limit=last legal offset (size-1)
   set_selector_limit(sel, nbytes - 1);

   return MK_FP(sel, 0);
}

// ...
unsigned char far *fp = map_real(0x522, some_length);
unsigned char some_byte = *fp;
// ...
free_selector(sel);
```

Figure 8: The C pseudocode for a map_real function that makes real-mode addresses accessible in a protected-mode program.

As indicated in Figure 10, we can use the undocumented SetSelectorBase/Limit calls to implement the map_real() function. Note that the documented AllocSelector() function uses an already existing selector as a model for the new selector. Since we want a normal data selector, we can just pass the program's DS as the parameter to AllocSelector().

We started discussing map_real() because NBWIN uses the SetSelectorBase() function. Even without knowing precisely how it uses SetSelectorBase(), NBWIN is obviously the sort of application that needs to access real-mode data structures, such as the BIOS data area, the floppy disk parameter table, the fixed disk parameter table, and so on.

On the other hand, Windows does provide a set of hard-wired selectors to access such popular absolute memory locations as A0000h, B8000h (yes, there are Windows applications, such as CodeView for Windows and Turbo Debugger for Windows that do direct screen writes), and F0000h. These selectors, which have names such as __A000H, __B800H and __F000H, are documented in Chapter 16 of the *Microsoft Windows Guide to Programming*, though they're not mentioned in WINDOWS.H or in the *Windows Programmer's Reference*. These are not functions, but global variables exported by the KERNEL module.

One of the hard-wired selectors used by NBWIN, __0040H, is not documented even in the *Guide to Programming*. As its name implies, this selector maps the BIOS data area at absolute memory location 400h. In a sense, __0040H is redundant, for there is yet another undocumented selector, __0000H, that maps the entire 64K of memory, starting at absolute location zero.

To best illustrate how these selectors can be used as an alternative to something like the map_real() function, we first need to see how to access the selectors from a C program. Because they are variables, accessing them is a little trick-

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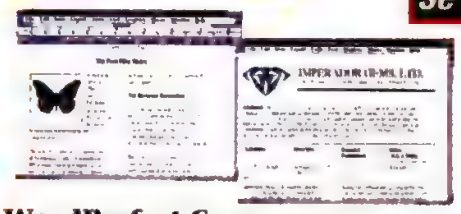

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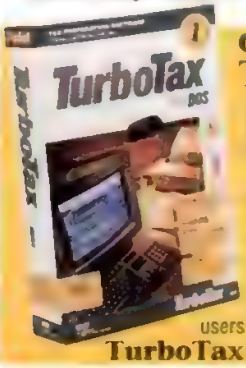

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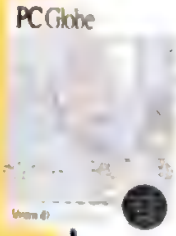

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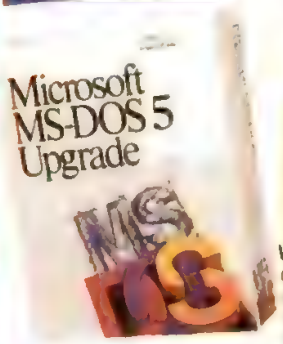

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MAP_REAL()

```
void far *map_real(void far *rmode_ptr, unsigned long nbytes)
{
    unsigned long base, limit;
    unsigned short sel;

    _asm mov sel, ds
    // sel starts off as copy of our DS: read/write data
    if ((sel = AllocSelector(sel)) == 0)
        return 0;

    base = (((DWORD) FP_SEG(rmode_ptr)) << 4) + FP_OFF(rmode_ptr);
    limit = nbytes - 1;

    SetSelectorBase(sel, base);
    SetSelectorLimit(sel, limit);

    return MK_FP(sel, 0);
}
```

Figure 10: The map_real() function is here implemented with the undocumented SetSelectorBase/Limit Windows API functions.

ier than simply declaring them, as we did with undocumented Windows functions.

The easiest way to access the Windows selectors is to use runtime dynamic linking. The usual form of dynamic linking isn't all that dynamic: It occurs when Windows loads a program into memory. With runtime dynamic linking, however, the program can do its own linking while running. To get a callable pointer to a function in a DLL or to access a variable in a DLL, a program need only know the ASCIIZ name of the DLL and of the item it wants to access. It passes the module name to a function such as LoadLibrary() or GetModuleHandle(), and the function name to GetProcAddress(). (Again, note how Windows uses ASCII strings, not just magic numbers.) When linking to variables rather than functions, we still use GetProcAddress(); the LOWORD() macro extracts the relevant portion.

A brief demonstration of how a C program would use one of the Windows selectors in order to read the machine's model value at absolute memory location FFFFEh (most 386-based AT-style clones have a model value of FCh), is shown in Figure 11.

Using the undocumented _ _0000H selector to access the first 64K of memory works in the same way. The following gives a protected-mode program access to the disk parameter table, which is at location 522h:

```
WORD _ _0000H =
        GET_SEL("_ _0000H");
DISK PARAM far *tbl =
        MK_FP(_ _0000H, 0x522);
```

Since the Windows selectors can be used in an MK FP() macro, you can see that these selectors can be used instead of the segment value that would be used in real mode (_ _F000H instead of 0xF000, for example). Likewise, they can often be used instead of the map_real() function we just built.

Given the existence of these hard-wired selectors and the fact that they can be called from a C program, why would anyone use the Set/GetSelectorBase/Limit functions? First of all, a program may not know to which addresses it needs access until runtime. Second, the Windows selectors, even if we include the incredibly useful but undocumented _ _0000H selector, leave a large area of memory inaccessible: 01000h to A0000h, plus all of extended memory (that is, absolute locations over 1MB). To access anything in this area (a buffer located within a real-mode TSR, for example), you would need something like our map_real() function, which uses SetSelectorBase/Limit.

On the other hand, there's a real reason why you might possibly want to stay away from the Get/SetSelectorBase/Limit functions, at least in Windows 3.0: Their implementation makes these functions potentially very dangerous, because no matter what selector value you actually pass in, the 3.0 KERNEL automatically assumes that the selector is in the LDT. There is no validity checking, and there is no provision against the possibility that you may have (probably mistakenly) passed in a GDT selector such as 40h. The 3.0 KERNEL does *not* use DPMI to implement these calls; instead, it directly hits the LDT. In Windows 3.1, however, these functions have been reimplemented in a safer fashion, using the underlying DPMI calls.

NEXT ISSUE

Part 2 of this article will take up such issues as whether it's safe to use undocumented functions, how to use them safely, and why they're undocumented in the first place. We'll also discuss such Windows API functions as Set/GetInternalWindowPos, IsWinOldApTask, Set/KillSystemTimer, GetExePtr, Get/SetTaskQueue, PrestoChangoSelector, GlobalMasterHandle, RegisterPtrace and WinDebug. Don't bother looking for any of these in your Windows API reference manual: They're not listed. ■

_ _F000H SELECTOR

```
#define GET_SEL(name) \
   ((WORD) (LOWORD(GetProcAddress(GetModuleHandle("KERNEL"), name))))

// ...
unsigned char far *fp;
WORD __F000H;
unsigned char model;

__F000H = GET_SEL("__F000H");
fp = MK_FP(__F000H, 0);
model = fp[0xFFFE];
```

Figure 11: The _ _F000H selector is used here in a C program to check for the machine's model number at an absolute memory address.

Andrew Schulman is a writer and engineer at Phar Lap Software (Cambridge, Mass.). He edited Undocumented DOS *(Addison-Wesley, 1990), and is coauthor of the forthcoming book* Undocumented Windows *(to be published by Addison-Wesley in 1992), from which this article is adapted.*

by
Charles Petzold

Environments

MCI Command Strings: The Easy Multimedia Interface

I began this series on waveform audio support in the Multimedia Extensions to Windows by discussing the low-level application program interface (API), which consists of functions beginning with the prefix wave. In the last issue, I started to explore the alternative high-level Media Control Interface (MCI) by looking at the mciSendCommand function. This function uses command messages and data structures to pass information to (and obtain information from) many different types of multimedia devices.

MCI also includes a text-based interface that lets you use relatively simple MCI command strings to control multimedia hardware. The text-based interface was originally designed for scripting languages that have better string-handling support than data structure support. But it turns out that these command strings make it very easy to work with the multimedia hardware interactively, and, needless to say, there's no better way to learn how to use MCI.

Two functions are provided for using the MCI text-based interface. The most versatile is mciSendString:

```
dwError = mciSendString
  (szCommand, szReturn, wLength,
  hwndCallback) ;
```

The first parameter is the MCI command string. Because some commands deliver text information back to the program, the second parameter points to a text buffer to receive this information. The third parameter is the length of this buffer. The last parameter is a handle to a window to receive notification messages (which I discussed in the last issue).

The mciSendString function returns zero if the function is successful or an error code if it's not. You can pass this error code to mciGetErrorString to get a text string that describes the error.

If you're not concerned with getting information back from the device, you don't want to deal with notification messages, and you'd like MCI itself to report errors to the user with message boxes, there's a very simple alternative function called mciExecute:

```
bSuccess = mciExecute
  (szCommand) ;
```

The only parameter is the MCI command string. The function returns a BOOL value—nonzero if the function is successful, zero if not. Basically, mciExecute is functionally equivalent to calling the mciSendString function with NULL or zero for the last three parameters, and then mciGetErrorString and MessageBox if an error occurs.

When you begin to explore the message-based and text-based interfaces to MCI, you'll find that they correspond very closely. It's easy to guess that MCI translates the command strings into the corresponding command messages and data structures. Obviously, I can't show you the complete syntax of all MCI command strings, but I'll show you enough to get you started.

- MCI includes a text-based interface that lets you use relatively simple command strings to control multimedia hardware, making it very easy to work with the hardware interactively.

EXPLORING MCI WITH MCITEST

The best tool for exploring the text-based version of MCI is the MCITEST program included with the Multimedia Developers Kit (MDK) and shown running under Multimedia Windows in Figure 1.

The easiest way to use this program is to type individual MCI commands in the main window. MCITEST uses mciSendString to execute these strings. If the command returns information, the information is displayed in the MCI Output window. The Error window shows any errors as reported by the mciGetErrorString function.

MCI command strings generally take the form

```
command device [arguments]
```

The *command* part of this string is a reserved word recognized by the MCI device driver. In this column, I'll be using the following MCI commands: open, play, pause, record, stop, status, and close. Some MCI commands are recognized by all devices while others are associated with particular devices.

The *device* part of the command string is either a device name, a filename, or an alias. You use a device name for devices that don't require disk files to record or play, such as CD-ROM drives playing music CDs in audio mode and videodisk players. If you have one CD-ROM drive, the device name is `cdaudio`. If you have two, the device names are `cdaudio1` and `cdaudio2`. These names are listed in the [mci] section of SYSTEM.INI. For example, here's what the [mci] section in

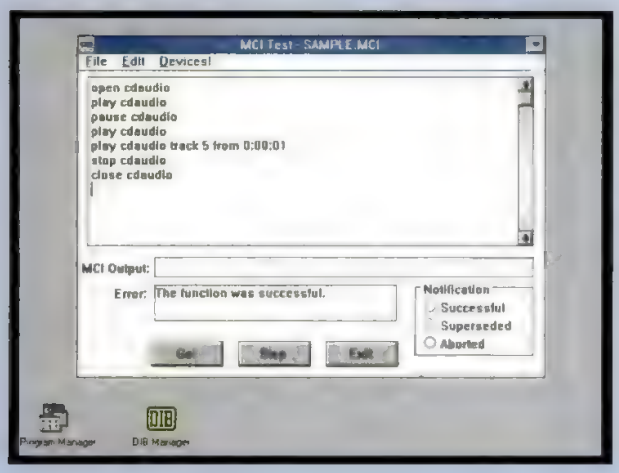

Figure 1: The MCITEST program included with the Multimedia Developers Kit is the best tool for exploring the text-based version of MCI.

my SYSTEM.INI file looks like:

```
[mci]
cdaudio=mcicda.drv
waveaudio=mciwave.drv
graphic=mcimmp.drv
sequencer=mciseq.drv
videodisc=mcipionr.drv
```

Each device name is followed by an equal sign and the MCI driver for the device. You can get a list of all MCI device names by calling GetPrivateProfileString with `mci` as the first parameter, NULL as the second parameter, and SYSTEM.INI as the last parameter.

For devices that use files (such as the waveform audio hardware or the MIDI synthesizer hardware) the device part of the MCI command string is a filename. Generally, you use a filename with a standard extension so the MCI driver knows what hardware you want to use. These standard extensions are listed in the WIN .INI file, like this:

```
[mci extensions]
wav=waveaudio
mid=sequencer
rmi=sequencer
mmm=graphic
```

The device name follows the filename extension.

To avoid repeating the device name or filename in every MCI command string that uses a particular device, you can specify an "alias" when you open the device. This alias is simply any text string you choose. You can then use the alias in subsequent MCI command strings.

CONTROLLING CD-ROM AUDIO

Let's begin experimenting with MCI command strings by taking control of the CD-ROM drive and playing an audio CD. This is a good place to begin, because the command strings are quite simple *and* you get to listen to some music. Make sure the audio output of your CD-ROM drive is connected to speakers or a headphone, pop in an audio compact disk (for example, Bruce Springsteen's *Born to Run*), bring up MCITEST, type in the following command:

```
open cdaudio
```

and press Enter. Open is an MCI command and `cdaudio` is a device name that MCI recognizes as the CD-ROM drive. (I'm assuming you have only one CD-ROM drive on your system.)

Now enter the command

```
play cdaudio
```

The CD will begin playing "Thunder Road," the first cut on the album. You can pause the CD by entering

```
pause cdaudio
```

and resume playing with

```
play cdaudio
```

Now try this command:

```
play cdaudio track 5 from 0:00:01
```

This instructs MCI to begin playing the fifth track on the album (which is the title song) from the beginning. The time format is in minutes, seconds, and frames, but it can be changed to milliseconds if you prefer.

Now let's try some status commands. You can enter these while the music is playing. If you enter this one

```
status cdaudio number of tracks
```

the MCI Output window in MCITEST will report the number of tracks on the CD (in this case, the text string "8"). This command

```
status cdaudio track 5 length
```

tells you the length of track 5, which is the text string "4:30:67"—4 minutes, 30 seconds, and 67 frames. You can obtain the current position from the beginning of the CD with the command

```
status cdaudio position
```

or from the beginning of the track with

BRUCE&ME.MCI — COMPLETE LISTING

```
open cdaudio
open bruce&me.wav type waveaudio alias song
record song
play cdaudio track 5 from 0:00:01 to 4:30:67 wait
stop song
save song
close song
stop cdaudio
close cdaudio
open bruce&me.wav type waveaudio alias song
play song wait
stop song
close song
```

Figure 2: This ASCII command script lets you record a duet with Bruce Springsteen.

RECORD3.MSC COMPLETE LISTING

```
#-----------------------------------------
# RECORD3.MSC make file for Microsoft C 6.0
#-----------------------------------------

record3.exe : record3.obj record3.def record3.res
     link record3,, NUL, /nod slibcew libw win87em mmsystem, record3
     rc -t record3.res

record3.obj : record3.c record3.h
     cl -c -G2sw -Ow -W3 -Zp record3.c

record3.res : record3.rc record3.h
     rc -r record3.rc
```

Figure 3: This is a Make file for the Microsoft C 6.0 Compiler and the Windows Software Development Kit.

this one:

```
status cdaudio position in track
```

When you're finished playing around with these commands, you can stop the CD by entering

```
stop cdaudio
```

and then close the device:

```
close cdaudio
```

If you don't stop the CD-ROM device before closing it, the CD will continue to play.

Obviously, it would be fairly easy to create a CD player program to play audio CDs from the comfort of your own computer keyboard. However, something even more interesting also becomes possible: If your program knows the time positions of key parts of the music, it can synchronize on-screen graphics with the CD. This feature is excellent for music instruction or for creating your own graphical music videos.

A DUET WITH BRUCE

Don't remove the *Born to Run* album from your CD player just yet, because we're going to do something a little bit silly with it. We're going to create a little MCI command script that controls both the CD-ROM drive and the waveform audio hardware so that you can record a duet with The Boss. You'll need about 3MB of hard disk space for this exercise.

Type the lines shown in Figure 2 into an ASCII text file with the name BRUCE&ME.MCI. Run the MCITEST program under Multimedia Windows and use the File Open command to load the BRUCE&ME.MCI command script into the program. Press the Go button. Within a couple of seconds, the "Born to Run" track should begin to play. Hold the microphone close to your speakers and sing along. The duet will be recorded on your hard disk in a waveform audio file with the name BRUCE&ME.WAV. When the song is over, the duet will be played back.

Of course, this won't sound all that great. For proper recording you'd really need to run the microphone and CD-ROM audio output into a sound mixer, and then run the output from the mixer directly into the waveform audio input jack. It would also help to have a high sampling rate and sample size, but that, of course, would create a larger sound file.

However, these are what we commonly refer to as "hardware problems," and that's really beside the point. The interesting aspect of this exercise is the software part—the fact we can carry off this minor feat with a 13-line MCI script. I find that pretty amazing.

THE MCI SCRIPT ANALYZED

So let's examine this MCI script and see how it works. The first line opens the CD-ROM drive for audio output, as shown earlier:

```
open cdaudio
```

The next line opens waveform audio hardware:

```
open bruce&me.wav type waveaudio
 alias song
```

The .WAV extension on the filename indicates waveform audio hardware. Just to make this very clear, I've added the option `type waveaudio`. I've also assigned an alias to this device, the word *song*. This alias is used as the device in subsequent MCI commands for the waveform audio hardware.

Next is a command to start recording waveform audio input:

```
record song
```

and then a command to begin playing the "Born to Run" track:

```
play cdaudio track 5 from 0:00:01
 to 4:30:67 wait
```

I've included both the `from` and `to` keywords to make sure we include only this cut. The `wait` keyword prevents this command (or rather, the mciSendString function call that MCITEST uses to execute this string) from returning until "Born to Run" is finished playing on the CD-ROM drive. Because Windows is nonpreemptive, you won't be able to do anything else during these 4½ minutes.

The next three commands in the script stop recording, save the results to the file

RECORD3.BCP COMPLETE LISTING

```
#-----------------------------------------
# RECORD3.BCP make file for Borland C++ 2.0
#-----------------------------------------

record3.exe : record3.obj record3.def record3.res
     tlink /c /n /Tw /Lc:\borlandc\lib c0ws record3, record3, NUL, \
           /nod cwins cs import maths mmsystem, record3
     rc -t record3.res

record3.obj : record3.c record3.h
     bcc -c -w-par -W -2 record3.c

record3.res : record3.rc record3.h
     rc -r -ic:\borlandc\include record3.rc
```

Figure 4: Use this Make file with the Borland C++ 2.0 Compiler.

BRUCE&ME.WAV, and close waveform audio hardware:

```
stop song
save song
close song
```

Then the CD-ROM drive is stopped and closed:

```
stop cdaudio
close cdaudio
```

Now we're ready to play back the duet. The waveform audio hardware is opened as before, with the newly created file:

```
open brucesme.wav type waveaudio
alias song
```

The next command in the script plays the waveform audio file and then waits until it's complete:

```
play song wait
```

After it's done, the waveform audio hardware is stopped and closed:

```
stop song
close song
```

When you run an MCI script in MCITEST using the Go button, you need to include the `wait` keyword in the `play` strings, as in the two here. Otherwise, the mciSendString function call would return as soon as playing began, and the next command (a `stop` in both cases) would then be executed, halting the play operation almost immediately.

THE RECORD PROGRAM AGAIN

In the last two issues, I showed a digital sound recorder program. RECORD1 used the low-level waveform audio API and RECORD2 used the message-and-structure form of MCI. Now it's time to take

RECORD3.C — **COMPLETE LISTING**

```
/*-----------------------------------------------------------
   RECORD3.C -- Multimedia Windows Waveform Audio Recorder
                (c) Charles Petzold, 1991
  -----------------------------------------------------------*/

#include <windows.h>
#include <mmsystem.h>
#include <stdio.h>
#include "record3.h"

BOOL FAR PASCAL DlgProc (HWND, WORD, WORD, LONG) ;

static char szAppName [] = "Record3" ;

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
                    LPSTR lpszCmdLine, int nCmdShow)
     {
     FARPROC lpDlgProc ;

     lpDlgProc = MakeProcInstance (DlgProc, hInstance) ;
     DialogBox (hInstance, szAppName, NULL, lpDlgProc) ;
     FreeProcInstance (lpDlgProc) ;

     return 0 ;
     }

BOOL FAR PASCAL DlgProc (HWND hwnd, WORD message, WORD wParam, LONG lParam)
     {
     static BOOL bRecording, bPlaying, bPaused ;

     switch (message)
          {
          case WM_COMMAND:
               switch (wParam)
                    {
                    case ID_RECORD_BEG:
                                        // Delete Existing Waveform File

                         remove ("record3.wav") ;

                                        // Open Waveform Audio and Record

                         if (!mciExecute ("open record3.wav alias mysound"))
                              return TRUE ;

                         mciExecute ("record mysound") ;

                                        // Change Enabled Buttons

                         EnableWindow (GetDlgItem (hwnd, ID_RECORD_BEG), FALSE);
                         EnableWindow (GetDlgItem (hwnd, ID_RECORD_END), TRUE) ;
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_BEG),   FALSE);
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_PAUSE), FALSE);
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_END),   FALSE);
                         SetFocus (GetDlgItem (hwnd, ID_RECORD_END)) ;

                         bRecording = TRUE ;
                         return TRUE ;

                    case ID_RECORD_END:
                                        // Stop, Save, and Close Recording

                         mciExecute ("stop mysound") ;
                         mciExecute ("save mysound") ;
                         mciExecute ("close mysound") ;

                                        // Change Enabled Buttons

                         EnableWindow (GetDlgItem (hwnd, ID_RECORD_BEG), TRUE) ;
                         EnableWindow (GetDlgItem (hwnd, ID_RECORD_END), FALSE);
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_BEG),   TRUE) ;
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_PAUSE), FALSE);
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_END),   FALSE);
                         SetFocus (GetDlgItem (hwnd, ID_PLAY_BEG)) ;

                         bRecording = FALSE ;
                         return TRUE ;

                    case ID_PLAY_BEG:
                                        // Open Waveform Audio and Play

                         if (!mciExecute ("open record3.wav alias mysound"))
                              return TRUE ;

                         mciExecute ("play mysound") ;

                                        // Change Enabled Buttons

                         EnableWindow (GetDlgItem (hwnd, ID_RECORD_BEG), FALSE);
                         EnableWindow (GetDlgItem (hwnd, ID_RECORD_END), FALSE);
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_BEG),   FALSE);
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_PAUSE), TRUE) ;
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_END),   TRUE) ;
                         SetFocus (GetDlgItem (hwnd, ID_PLAY_END)) ;

                         bPlaying = TRUE ;
                         return TRUE ;

                    case ID_PLAY_PAUSE:
                         if (!bPaused)
                                        // Pause the Play
                              {
                              mciExecute ("pause mysound") ;
                              SetDlgItemText (hwnd, ID_PLAY_PAUSE, "Resume") ;
                              bPaused = TRUE ;
                              }
                         else
                                        // Begin Playing Again
                              {
                              mciExecute ("play mysound") ;
                              SetDlgItemText (hwnd, ID_PLAY_PAUSE, "Pause") ;
                              bPaused = FALSE ;
                              }
                         return TRUE ;

                    case ID_PLAY_END:
                                        // Stop and Close

                         mciExecute ("stop mysound") ;
                         mciExecute ("close mysound") ;

                                        // Change Enabled Buttons

                         EnableWindow (GetDlgItem (hwnd, ID_RECORD_BEG), TRUE) ;
                         EnableWindow (GetDlgItem (hwnd, ID_RECORD_END), FALSE);
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_BEG),   TRUE) ;
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_PAUSE), FALSE);
                         EnableWindow (GetDlgItem (hwnd, ID_PLAY_END),   FALSE);
                         SetFocus (GetDlgItem (hwnd, ID_PLAY_BEG)) ;

                         bPlaying = FALSE ;
                         bPaused  = FALSE ;
                         return TRUE ;
                    }
               break ;

          case WM_SYSCOMMAND:
               switch (wParam)
                    {
                    case SC_CLOSE:
                         if (bRecording)
                              SendMessage (hwnd, WM_COMMAND, ID_RECORD_END, 0L);

                         if (bPlaying)
                              SendMessage (hwnd, WM_COMMAND, ID_PLAY_END, 0L) ;

                         EndDialog (hwnd, 0) ;
                         return TRUE ;
                    }
               break ;
          }
     return FALSE ;
     }
```

Figure 5: This listing contains all the C source code for the program.

a look at RECORD3, which simplifies the program considerably by using the string-based form of MCI and the mciExecute function. The files for the RECORD3 program are shown in Figures 3 through 8.

As usual, if you're using Microsoft C 6.0 and the Windows Software Development Kit, you can create RECORD3.EXE by executing

```
NMAKE RECORD3.MSC
```

If you're using the Borland C++ 2.0 Compiler, execute the command

```
MAKE -fRECORD3.BCP
```

In either case, you must also have the Multimedia Developers Kit installed. If you're using the Borland compiler, the MDK should be installed in the same directory as the compiler. You can also download the source code files and the RECORD3.EXE executable from PC MagNet.

RECORD3 is so straightforward and clear that it hardly makes sense to discuss the program in detail. When opening the waveform audio device (during the WM_COMMAND messages when wParam is ID_RECORD_BEG or ID_PLAY_BEG), all that is specified is a filename and the alias `mysound`. The program checks the return value of mciExecute to make sure the device was opened. If the open operation fails, by the time mciExecute returns, a message box has already been displayed to the user reporting the problem. All the other MCI commands are simply `record`, `play`, `pause`, `stop`, `save`, and `close` followed by the alias name.

ANOTHER APPROACH

Compared with RECORD2, RECORD3 has one deficiency: When a particular waveform file is played, the program cannot detect when the file has been completed. Therefore, the buttons don't automatically change state. You must manually press the End button so the program knows that it's ready to record or play again.

RECORD3.H — COMPLETE LISTING

```
/*-----------------------
  RECORD3.H header file
 -----------------------*/

#define ID_RECORD_BEG     10
#define ID_RECORD_END     11
#define ID_PLAY_BEG       12
#define ID_PLAY_PAUSE     13
#define ID_PLAY_END       14
```

Figure 8: This header file defines constants used in both the C code and resource script.

This deficiency is a direct result of using mciExecute rather than mciSendString. The mciExecute function can't perform notifications because it has no handle to a window to which it can send the notification message. You can correct the problem by using mciSendString rather than mciExecute for the send and record commands, setting the second parameter of mciSendString to NULL and the third to 0, and specifying the program's window handle as the last parameter. Also, when using the `send` and `record` commands, include the keyword `notify` after the alias name. If you do this, you'll receive an MM_MCINOTIFY message when playback of a waveform file has completed, or when you run out of hard disk space during a record operation. You should process this message exactly as shown in RECORD2.

If you want, you can freely mix mciSendString, mciExecute, and mciSendCommand calls in the same program. I've spoken of the different "forms" of MCI, but they are really all the same interface. The mciExecute function translates into mciSendString and mciGetErrorString calls, and mciSendString translates into mciSendCommand calls.

So, if you spend a lot of time in MCITEST experimenting with different devices, operations, and options, you'll get a very full understanding of MCI and you'll be able to use it in either form. The multimedia folks at Microsoft encourage the use of MCI rather than the low-level interface for controlling waveform audio and the MIDI synthesizer hardware.

In the next installment of this column I'll wrap up this series on waveform audio with a discussion of the waveform file format and two very simple functions for playing (but not recording) waveform audio—sndPlaySound and a variation of MessageBeep, a function that's been in Windows since Version 1.0. And then we'll attack MIDI! ■

RECORD3.RC — COMPLETE LISTING

```
/*----------------------------
  RECORD3.RC resource script
 ----------------------------*/

#include <windows.h>
#include "record3.h"

Record3 DIALOG 32768, 0, 152, 52
     STYLE WS_OVERLAPPED | WS_CAPTION | WS_SYSMENU | WS_MINIMIZEBOX | WS_VISIBLE
     CAPTION "Waveform Audio Recorder"
     {
     DEFPUSHBUTTON "Record"  ID_RECORD_BEG,  28,  8, 40, 14
     PUSHBUTTON    "End"     ID_RECORD_END,  76,  8, 40, 14, WS_DISABLED

     PUSHBUTTON    "Play"    ID_PLAY_BEG,     8, 30, 40, 14, WS_DISABLED
     PUSHBUTTON    "Pause"   ID_PLAY_PAUSE,  56, 30, 40, 14, WS_DISABLED
     PUSHBUTTON    "End"     ID_PLAY_END,   104, 30, 40, 14, WS_DISABLED
     }
```

Figure 6: Here's the resource script with the definition of the program's window.

RECORD3.DEF — COMPLETE LISTING

```
;-----------------------------------
; RECORD3.DEF module definition file
;-----------------------------------

NAME            RECORD3

DESCRIPTION     'Waveform Audio Recorder (c) Charles Petzold, 1991'
EXETYPE         WINDOWS
STUB            'WINSTUB.EXE'
CODE            PRELOAD MOVEABLE DISCARDABLE
DATA            PRELOAD MOVEABLE MULTIPLE
HEAPSIZE        1024
STACKSIZE       8192
EXPORTS         DlgProc
```

Figure 7: Here's the program's module definition file.

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by
Ray Duncan

Power Programming

Adding a Pen to Windows: A Look at The Pen Windows API

In last issue's Power Programming column, we looked briefly at the two major software platforms that seem most likely to be dominant on the new pen computers: GO Corp.'s PenPoint, and Microsoft's Windows for Pen Computing, colloquially known as Pen Windows. As you'll recall, a pen computer is characterized by an integrated display and stylus-oriented entry device and does not depend on a traditional keyboard (it may not even support one!). The operating systems for pen computers must therefore support the translation of handwritten characters into text, the recognition of gestures (stereotyped movements for editing and navigation), and inking (tracking a stylus on the display and turning on pixels under the point as though the user were writing on paper).

Here, we'll examine Pen Windows in more detail. Pen Windows is not really a distinct product from Windows (although it may be marketed as one), but can be thought of as being everything that is in ordinary Windows plus an assortment of pen-specific dynamic link libraries (DLLs) and device drivers. Application programs that run on Pen Windows fall into one of three groups:

- *Pen-oblivious* applications, which know nothing of special Pen Windows capabilities (that is, off-the-shelf Windows applications);
- *Pen-aware* applications, which test for the presence of Pen Windows and modify their user interface accordingly (Microsoft calls these *pen-enhanced*); and
- *Pen-centric* applications, which require Pen Windows and will not run on a baseline Microsoft Windows system.

Pen-oblivious programs are supported by Pen Windows partly by mouse emulation and partly via an "applet" called PenPal. The mouse emulation basically works by converting selected pen events to mouse events. The user can launch programs, move or resize windows, pick items from pop-up menus, and select radio buttons or check boxes by tapping or dragging the stylus on those objects just as he would a mouse. PenPal is a small utility that floats on the desktop alongside the pen-oblivious application, intercepts pen input and translates it into characters, and then feeds the characters to the application exactly as though they were coming from the keyboard. PenPal also has a pop-up graphical keyboard that allows the user to "type" by tapping the pen directly on images of the desired keys.

> ■ Pen Windows is not a product distinct from Windows; it is everything that is in ordinary Windows plus an assortment of pen-specific dynamic link libraries (DLLs) and device drivers.

PenPal is a clever accessory, but it's totally inadequate for any kind of serious work under Pen Windows. For example, no user in his or her right mind would try to create even the shortest of memos with it. So the question becomes: Do you believe that pen computers will be an important product category with rapidly accelerating sales, or is the computer trade press merely whipping itself into a frenzy over a technically interesting product category with limited applications and a poorly defined future?

Guessing wrong (in either direction) can be a hideously expensive mistake, as companies who made early entries into the OS/2 or CD-ROM markets or late entries into the Windows market found out. If you believe that pen computers will find rapid acceptance, you can hedge your bets by making your software pen-aware. Or you can play for much bigger stakes, rewriting your application for pen-centricity and seizing the opportunity to outdo the pen-aware or pen-oblivious competition and set new standards.

WHAT'S NEW IN PEN WINDOWS

From the application programmer's point of view, Pen Windows consists of some 70 new API functions, about 10 new structures, a few new manifest constants and window messages, and a couple of new control types. The primitive building blocks of the system that provide its basic functionality—the pen driver that digitizes pen input and turns it into a stream of *x,y* coordinates, the display driver that supports inking, the recognition context (RC) manager, and the recognizer module that translates streams of *x,y* coordinates into symbols—are mercifully hidden beneath the API and can initially be ignored. (The recognizer module provided by Microsoft, named MARS.DLL, is replaceable, even on an application-by-application basis. However, only the most ambitious developers with extensive experience in pattern recognition, OCR, or maybe neural networks will want to delve into this area.)

The new Pen Windows API functions can be grouped into seven categories:

- Pen interface functions that add pen capabilities to an application. Most pen-

API FUNCTIONS USED BY PEN-AWARE APPLICATIONS

Function	Description
AtomicVirtualEvent	Blocks out physical events while posting virtual events.
BoundingRectFromPoints	Returns the bounding rectangle of an array of points.
CharacterToSymbol	Converts an ANSI string to a symbol value array.
CorrectWriting	Displays EDIT text window.
DPtoTP	Converts display coordinates to tablet coordinates.
EmulatePen	Emulates text I-beam. In general, applications should use ProcessWriting or HEDIT controls instead.
EnumSymbols	Enumerates strings of symbols from a symbol graph.
FirstSymbolFromGraph	Returns the array of symbols that is the most likely interpretation of a specific symbol graph.
GetGlobalRC	Gets current default settings for the specified recognition context.
GetInkProperties	Returns the current ink property values.
GetMessageExtraInfo	Windows 3.1 function used to extract extra information passed along with mouse event messages.
GetSymbolCount	Returns the number of possible strings that can be generated from the symbol graph.
GetSymbolMaxLength	Gets the length of the longest symbol string generated from the symbol graph.
InitRC	Initializes recognition context for the recognizer.
InstallRecognizer	Installs a specific recognizer.
PostVirtualKeyEvent	Sends a virtual key code event to Windows.
PostVirtualMouseEvent	Sends a virtual mouse event to Windows.
ProcessWriting	Runs high-level recognition services.
Recognize	Begins sampling pen data from the tablet and converts the input to recognized symbols.
RecognizeData	Converts pen data stored in a buffer to recognized symbols.
RegisterPenApp	Modifies the behavior of edit controls within an application to behave as HEDIT controls.
SetGlobalRC	Forces default settings for the specified recognition context.
SetInkProperties	Sets ink property values.
SetPenHook	Captures low-level pen events.
SetRecogHook	Installs or removes a recognition hook.
SymbolToCharacter	Converts an array of symbols to an ANSI string.
TPtoDP	Converts tablet coordinates to display coordinates.
TrainContext	Application entry point to TrainContextInternal.
TrainContextInternal	Informs the recognizer that the raw data input represents the symbol value results using contextual information.
TrainInk	Application entry point to TrainInkInternal.
TrainInkInternal	Informs the recognizer that the raw data input represents the symbol value in a context-free manner. The lowest level of training.
UnInstallRecognizer	Unloads the specified recognizer.

Figure 1: The pen interface group of API functions supported by Pen Windows. The functions in the other six pen API groups, which are not used by typical applications, are not listed.

aware applications use only the functions in this category (see Figure 1).

- Pen module functions that support pen-mode and mouse-mode events, data collection, and transformations of pen data. These are called by pen-centric applications, the recognizer, and the pen driver.
- Pen data functions that manipulate a structure used to pass data captured from a pen between applications or between an application and a recognizer.
- Custom recognizer functions, which are provided by a recognizer module for use by Pen Windows. Ordinarily, these are not called directly from an application.
- Pen driver functions (called by Pen Windows).
- Display driver functions (called by Pen Windows).
- Dictionary functions (called by the recognizer).

The two new edit controls supported by Pen Windows have the class names HEDIT and BEDIT. HEDIT controls are very similar to traditional Windows EDIT controls except that they accept handwritten input and editing gestures as well as the more conventional keyboard events. Essentially, recognition and translation of handwritten input in an HEDIT control takes place transparently. BEDIT controls are an entirely new class of control that looks like handwriting "combs" you often find on a subscription or registration card. Each "box" of the "comb" accepts and translates a single character. A BEDIT control is not as flexible as an HEDIT control, but it trades flexibility for increased accuracy. An application uses the familiar EM_xxxx and EN_xxxx messages to communicate with HEDIT and BEDIT controls, as well as a new message WM_HEDITCTL and a new class of notification messages that begin with the prefix HN_xxxx. The HEDIT and BEDIT controls can be seen in Figure 2.

CONVERTING APPLICATIONS

If you've got an existing, working Windows application and you want to make it pen-aware (but at the same time allow it to run under ordinary Windows), the first step is to carefully analyze its user interface and overhaul it wherever possible to eliminate edit fields in favor of radio buttons, check boxes, menus, lists, toolbars, and palettes. Although the recognizer in Pen Windows is fairly good, it is far from perfect, and any place you can eliminate the need for the recognizer

in your application's dialog boxes you will make the user's life easier. The next step is to check for the presence of Pen Windows in your application's startup code—typically in the routine InitInstance(), if your program is patterned after the Microsoft example programs—with a call to GetSystemMetrics() using the new parameter SM_PENWINDOWS. If the value of the function is nonzero, Pen Windows is running, and the returned value is the "Pen Windows module handle." If the value is zero, Pen Windows is not present, and your application should proceed using its normal keyboard and mouse look-and-feel.

Assuming that Pen Windows is running, the next step is for your application to call GetProcAddress() to retrieve the entry points for the RegisterPenApp() function and any other Pen Windows functions it intends to call. (We don't want to simply hard-wire calls to the Pen Windows-specific functions into the program because then it would refuse to load under normal Windows.) It should then call RegisterPenApp() to notify the system that it is pen-aware before creating any edit controls. This has the immediate effect that all edit controls in the application (including those in combo boxes) will automatically be converted to HEDIT controls by the system. At this point, the application can also install a custom recognizer if it needs to with the InstallRecognizer() function, making sure to remove it from the system before termination by calling UnInstallRecognizer().

For data entry applications consisting of simple forms and dialog boxes, the process we've just described might be a sufficient adaptation for Pen Windows. But for word processors and drawing/painting programs, it would be only the beginning. For example, you would need to divide your application's main window into pointing and writing areas. Pen Windows provides some fairly high-level functionality to help you along, though. When you detect a "pen down" condition within the writing area, you can call ProcessWriting(), which takes over and creates an invisible HEDIT window over the writing area. ProcessWriting() proceeds to trap all pen activity within the writing area, converts the writing to text, and then sends the characters to the current insertion point. Of course, your application can also control inking and recognition at a much lower level if it needs to.

In next issue's Power Programming column, we'll look at the source code for a simple Pen Windows application and see how these functions actually work.

ESSENTIALS FOR DEVELOPMENT

As I write this, in order to embark on Pen Windows development at all, you need to be a member of the Windows 3.1 beta test program, you need Microsoft C, Version 6.0, and you need three separate (but synchronized) packages of beta test software from Microsoft: the Windows 3.1 retail product, the Windows 3.1 Software Development Kit (SDK), and the Windows for Pen Computing Software Development Kit (Pen SDK). Each successive release of each of the three beta test packages has tended to break the other two, so you have to be very conservative about installing any new disks as they arrive from Microsoft until you have received a complete matching set of the three packages. Microsoft has not yet announced packaging plans or release dates for retail Windows, Version 3.1, the Windows 3.1 SDK, or the Pen SDK, but it does appear unlikely that any of the three will reach "golden master" status by the time this column is in print.

Turning our attention to hardware, you definitely want a very high-end machine if you are going to do Pen Windows software development (or any kind of Windows development for that matter). Windows itself and your application will typically run fine on a 16- or 20-MHz 386SX with sufficient memory, but the Microsoft development tools are real CPU hogs; there is no way that you can have too much horsepower under the hood when you are trying to get work done with the Microsoft C Compiler, Linker, Resource Compiler, CodeView, and especially the notorious Windows Help Compiler. The disk space requirements are awesome as well: MS-DOS 5.0, Windows 3.1, the Windows SDK, the Pen Windows SDK, the C compiler with one or two of the memory models, and your favorite programming editor will take up most of a 40MB hard disk—even before you start to think about the disk space requirements of your own source code, network software, word processor (for creating your product's help files), and any other tools you may be fond of (such as source code control tools or the Borland Resource Toolkit).

Consequently, based on my own personal experience, I recommend a minimum configuration of a 33-MHz 386 with cache, Super VGA (800 by 600), 4MB of RAM, a 100MB hard disk, and a tape backup. A better but hardly extravagant platform would be an 486 machine with 8MB of RAM, Super VGA (1,024 by 768), a 200MB hard disk, and a Bernoulli drive for backup. If you are seriously contemplating the development of a pen-aware or pen-centric application, you will definitely need a integrated pen-input/display device to test it on. The pen-emulation mouse driver shipped by Microsoft with the Pen SDK can be viewed only as a temporizing measure while you are deciding on a true pen-input/display device. I don't recommend that you invest in a separate pen computer at this point for a few reasons: Pen computers will evolve

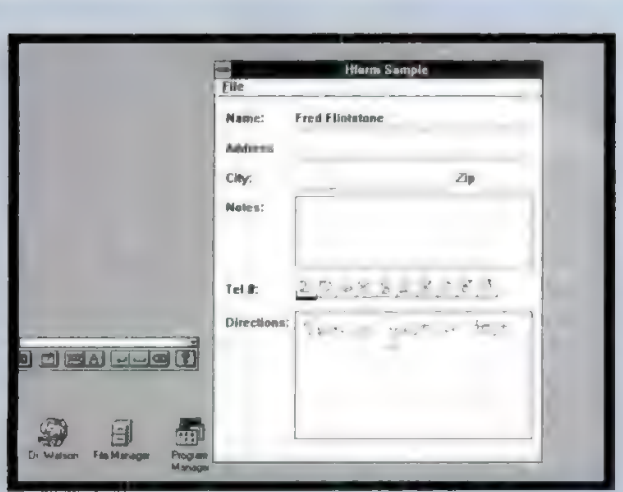

Figure 2: This sample application included in the Pen Windows SDK uses both HEDIT and BEDIT controls. The screen shot is monochrome VGA resolution, captured on the Wacom 648A.

rapidly over the next couple of years, their prices will fall, and introducing another computer into the situation means that you will constantly be transferring files back and forth between your development machine and your test machine. I also don't recommend purchasing old-fashioned digitizing tablets, even though they are relatively inexpensive; looking at the screen while writing somewhere else does not give you the true feel of a pen application. The Pen Windows SDK currently supports two integrated pen-input/display devices that can be hooked up to a conventional PC: the Wacom 648A and the Scriptel PenWriter 100.

Wacom and Scriptel were each kind enough to send us their products for evaluation. Both support monochrome graphics at VGA resolution and send their pen output to the computer via a COM port. The Wacom device has two advantages: It does not require a separate adapter card (the display's cable plugs directly into any standard VGA connector) and it has a non-tethered pen. The Scriptel device requires its own ISA adapter card (if you are a PS/2 user, you are out of luck) and it has a tethered pen. On the other hand, the Scriptel product is considerably less expensive (approximately $1,500, versus $3,050 for the Wacom tablet). Both products perform well and look good in graphics mode (but have very ugly fonts in text mode), and both have perfectly dreadful manuals (which, fortunately, you will never need to consult since you simply plug the tablets in and go to work).

For further information, you can contact the companies directly at: Wacom Inc., Attn.: Microsoft Windows Developer Support, W. 115 Century Rd., Paramus, NJ 07652; 201-368-1388, fax: 617-265-4722. Scriptel Corp., Attn.: Microsoft Windows Developer Support, 4145 Arlingate Plaza, Columbus, OH 43228; 614-276-8402, fax: 614-276-7615.

ADDITIONAL REFERENCE MATERIALS

If you need to get oriented to the pen computing sector in a hurry, and your company has deep pockets, you should consider purchasing *Pen Computing 1991, The Industry Guide* from Technologic Partners for $395. This guide comes packaged in a big hard box and has two parts: a softcover book and a set of folders. The book contains a survey of the industry by analysts at Technologic Partners, excerpts from the recent Pen Computing 1991 conference, contact information for companies and their executives, and some essays written by various pen computing gurus and promoters. The folders contain an alphabetically filed collection of "backgrounder" briefing sheets, product data sheets, and press releases from various companies involved in pen computing. You could probably find nearly all the information in *Pen Computing 1991* yourself at considerably less expense, given enough time, but it certainly is an efficient way to get started and the forecasts and essays are quite interesting. Technologic Partners is located at 419 Park Ave. South, # 500, New York, NY 10016; 212-696-9330, fax: 212-696-9793.

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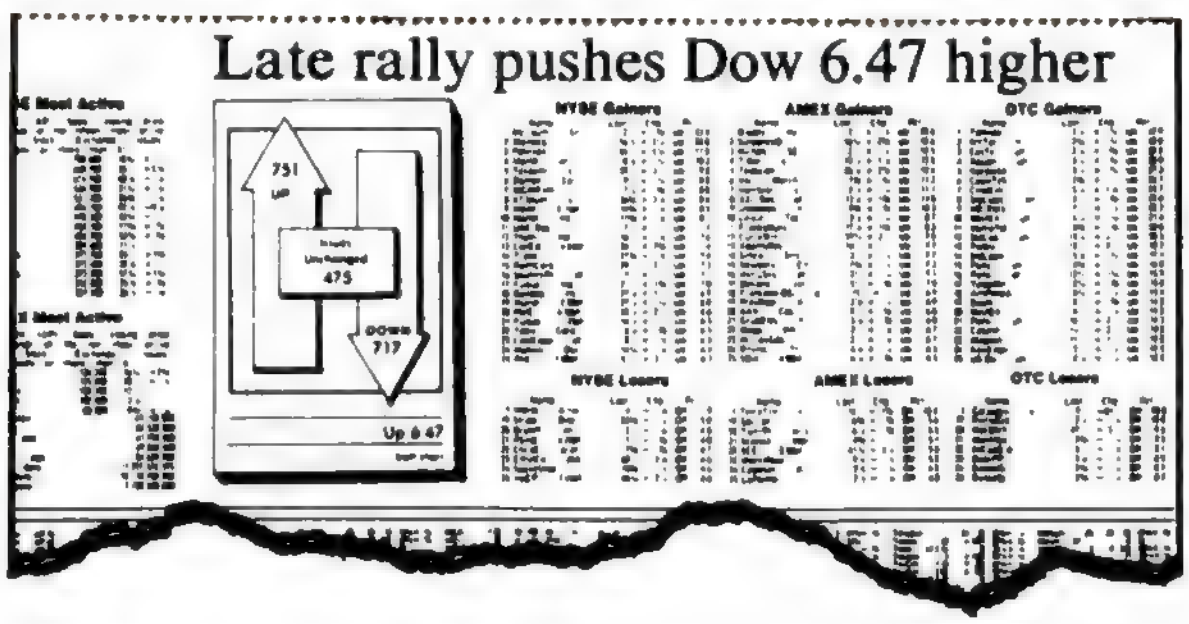

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by
Sal Ricciardi

Databases

PARADOX COLOR CODES

I often have trouble remembering the color codes used by PAL (Paradox Application Language). Other products, like *dBASE*, use mnemonics such as W/R to symbolize a white foreground on a red background. That's certainly easier to remember than 79, the *Paradox* equivalent. One way to get around this is to use a script that includes statements to assign the colors to variables, such as

```
BrtWhiteOnBlue = 31
```

Although this is easier to remember, setting up all the colors this way is a lot of work, and you'd still have to remember exactly what names you assigned to the colors.

I decided that a simple pop-up chart would be the best way to refresh my memory, and so the code in Figure 1 is what I came up with. I simply assign the routine to a key (I use Shift-F7) in my INIT script. I then hit that key whenever I want to see a pop-up chart of PAL color codes.

Con Foss
Mt. Vernon, Washington

- PARADOX COLOR CODES: A pop-up chart that helps you remember *Paradox*'s color codes.
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This certainly makes remembering those color codes a lot easier. The code shown in Figure 1 is customized to my environment. You'll want to change the two lines that contain

```
"X:\\PDOXPRIV\\Mylib"
```

to use a drive, directory, and library name of your own.

The COLOR script creates the two procedures ClrChrt and Box and places them in a procedure library named Mylib. Procedure libraries store *Paradox* procedures in a sort of precompiled format that can be executed much faster than standalone scripts. The ClrChrt procedure is the one that draws our color chart, while the Box procedure is a subroutine called by ClrChrt itself.

Whenever *Paradox* starts up, it looks for a script named INIT.SC in your current directory, or, if you're on a network, in your private directory. By binding the ClrChrt procedure to a keystroke combination in your INIT script, you can make ClrChrt available at all times from within *Paradox*.

COLOR.SC — COMPLETE LISTING

```
;*****************************************************************
; COLOR.SC                    Paradox procedure to pop-up a color chart
;*****************************************************************

CREATELIB "X:\\PDOXPRIV\\Mylib"              ; Create library

;-----------------------------------------------------------------
; ClrChrt()
; Paradox Procedure to draw a color/attrib chart
;-----------------------------------------------------------------
PROC CLOSED ClrChrt()
   USEVARS Autolib
   q = 0
   i = 0
   n = 0

   CANVAS OFF
   Box(4, 5, 21, 73, "[redacted]", 127, True)  ; Draw box for chart

   @ 5, 7
   FOR i FROM 0 to 15                          ; outer loop - does rows
      FOR n FROM 0 to 15                       ; inner loop - does columns
         STYLE ATTRIBUTE q                     ; set attribute (color)
                                     ; write attribute code in attribute color
         @ ROW(),COL() ?? FORMAT("W4,EX",q)

         q = q + 1                             ; increment attribute
      ENDFOR                                   ; loop inside
      @ROW() + 1, 7                            ; increment row
   ENDFOR                                      ; loop outside
   STYLE ATTRIBUTE 113
   @ 4, 29 ?? " Paradox Color Chart "

   CANVAS ON                                   ; display canvas
   n = GETCHAR()                               ; hold until user presses
                                               ; a key.
ENDPROC

;-----------------------------------------------------------------
```

```
; Box (TROW, TCOL, BROW, BCOL, char, color, shadow)
; Paradox procedure to draw a filled box with optional drop shadow.
;-----------------------------------------------------------------
PROC CLOSED Box (TROW, TCOL, BROW, BCOL, char, color, shadow)
   tlc      = SUBSTR(char, 1, 1)
   top      = SUBSTR(char, 2, 1)
   trc      = SUBSTR(char, 3, 1)
   side     = SUBSTR(char, 4, 1)
   blc      = SUBSTR(char, 5, 1)
   brc      = SUBSTR(char, 6, 1)
   fillchar = SUBSTR(char, 7, 1)

   wide    = BCOL - TCOL - 2
   high    = BROW - TROW - 1
   i       = 0

   IF shadow = TRUE THEN            ; Draw shadow or don't
      PAINTCANVAS ATTRIBUTE 8+7 TROW+1, TCOL+1, BROW+1, BCOL+1

   ENDIF

   STYLE ATTRIBUTE color            ; Set color as passed in 'color' parm

   ; Draw each box row as a string made up of the box chars
   ; and the fillchar. First, the top row, then a loop to do all
   ; the interim rows - and finally the bottom row.

   @TROW, TCOL ?? tlc + FILL(top,wide) + trc

   FOR i FROM 1 TO high
         @TROW + i, TCOL ?? side + FILL(fillchar,wide) + side
   ENDFOR

   @BROW, TCOL ?? blc + FILL(top, wide) + brc
ENDPROC

WRITELIB "X:\\PDOXPRIV\\Mylib" ClrChrt, Box
```

Figure 1: A procedure that displays a chart of the *Paradox* color codes.

INIT.SC — COMPLETE LISTING

```
;*********************************************************************
; INIT.SC
; Init script for Paradox.
;*********************************************************************
Autolib = "X:\\PDOXPRIV\\Mylib"
SETKEY -90 ClrChrt()                ; Set up Shift-F7 to call clrchrt()
```

Figure 2: An example INIT script that sets up the Mylib procedure library as an autoload library and binds the color chart procedure to the Shift-F7 key.

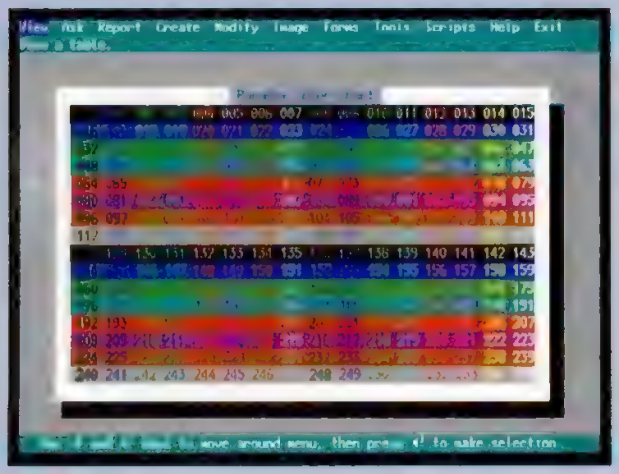

Figure 3: You can pop up this color chart while programming in PAL, using the code shown in Figures 1 and 2.

A sample *Paradox* INIT script is shown in Figure 2. The script starts by setting up the Mylib procedure library, which contains ClrChrt, as an autoload library. This means that *Paradox* will automatically search Mylib when it encounters calls to procedures that haven't been explicitly defined.

The second command, SETKEY, binds the ClrChrt procedure to the Shift-F7 key combination. If *Paradox* finds the INIT script when it starts up, it will execute it, and you'll be able to hit the Shift-F7 key combination to see the display shown in Figure 3.

FIELDGET AND FIELDPUT

I often need to copy values from a record in one work area to an existing record in another work area. Prior to *Clipper* 5.0, this required the use of macro expansion to operate in a generic fashion. Using *Clipper* 5.0's FIELDGET() and FIELDPUT() functions, you can transfer the information quickly—without using the macro operator. The function Rec2Rec(), shown in Figure 4, performs the transfer. All you have to do is pass it the destination work area number.

You can also use FIELDGET() and FIELDPUT() to create generic functions that populate an array from a record and that populate a record from an array. The functions Rec2Array() and Array2Rec(), shown in Figure 5, do just that.

Note that Rec2Array() returns an array and Array2Rec() uses the array iterator function AEVAL() in order to evaluate the FIELDPUT() function on each element of the array.

Mike Schinkel
Atlanta, Georgia

All three of these functions are useful, generic routines made possible by new features built into *Clipper* 5.0.

Clipper's FIELDGET() function retrieves the contents of a field based on its ordinal position in the database structure. That is, if your database layout looks like this

Name	Type	Len	Dec
LAST	C	40	0
FIRST	C	30	0
ADDR1	C	50	0

then, FIELDGET(1) would return the contents of LAST, FIELDGET(2) would return the contents of FIRST, and so on. The FIELDPUT() function operates in a similar fashion, accepting a field number and an expression to store in the field.

These functions, combined with FCOUNT(), which returns the number of fields, make it easy to use a loop to operate on each field in a record without having to know the structure of the database and without having to use the macro operator, which is slow.

The Rec2Rec() function shown in Figure 4 is useful for copying the current record to a target database with the same structure. For example, if you want to copy record 1 from the source database to record 5 in the target database, you could use

REC2REC FUNCTION — COMPLETE LISTING

```
*********************************************************************
* FUNCTION Rec2Rec( nToArea )                          Clipper 5.01
* Copy current record in current work area to current
* record in destination workarea
*********************************************************************
FUNCTION Rec2Rec( nToArea )
LOCAL i, nFCnt:= FCOUNT()                 && Get field count
nFromArea:= SELECT()                      && Get current work area

SELECT ( nToArea )                        && Select destination work area

FOR i:= 1 TO nFCnt                        && Loop through, copying fields
   FIELDPUT( i, ( nFromArea )->( FIELDGET( i ) ) )
NEXT

SELECT ( nFromArea )                      && Return to from work area
RETURN                                    && Return to caller
```

Figure 4: This *Clipper* UDF (user-defined function) copies the current record in the current work area to the current record in the target work area.

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REC2ARRAY AND ARRAY2REC — **COMPLETE LISTING**

```
*********************************************************************
* FUNCTION Rec2Array()                                   Clipper 5.01
* Copy record from current work area into an array
*********************************************************************
FUNCTION Rec2Array()
LOCAL nFCnt:= FCOUNT()                  && Get field count
LOCAL i, aArray[ nFCnt ]                && Create the array

FOR i:= 1 TO nFCnt                      && Loop through, storing each
   aArray[ i ]:= FIELDGET( i )          && field in an array element
NEXT
RETURN aArray                           && Return the array

*********************************************************************
* FUNCTION Array2Rec( aArray )                           Clipper 5.01
* Copy an array to the current record in the current work area
*********************************************************************
FUNCTION Array2Rec( aArray )
AEVAL( aArray, {| v, i | FIELDPUT( i, v ) } )    && Write the array
RETURN
```

Figure 5: These two *Clipper* functions store the contents of a record in an array, and replace a record with the contents of an array, respectively.

```
SELECT 2
USE TARGET
GOTO 5
SELECT 1
USE SOURCE
Rec2Rec( 2 )
```

As long as the two databases have the same structure, this will work smoothly. Otherwise, a "datatype error" will occur.

The Rec2Array() function shown in Figure 5 creates and returns an array, populated with the current record. For example, to create an array and fill it with the current record, you could use

```
myarray := Rec2Array()
```

You don't have to create `myarray` prior to calling the function.

Last but not least, Array2Rec() does the opposite of Rec2Array(). For example, to replace the current record with the contents of `myarray` you would use the following line:

```
Array2Rec(myarray)
```

These three functions are available in REC2RE.ZIP on PC MagNet.

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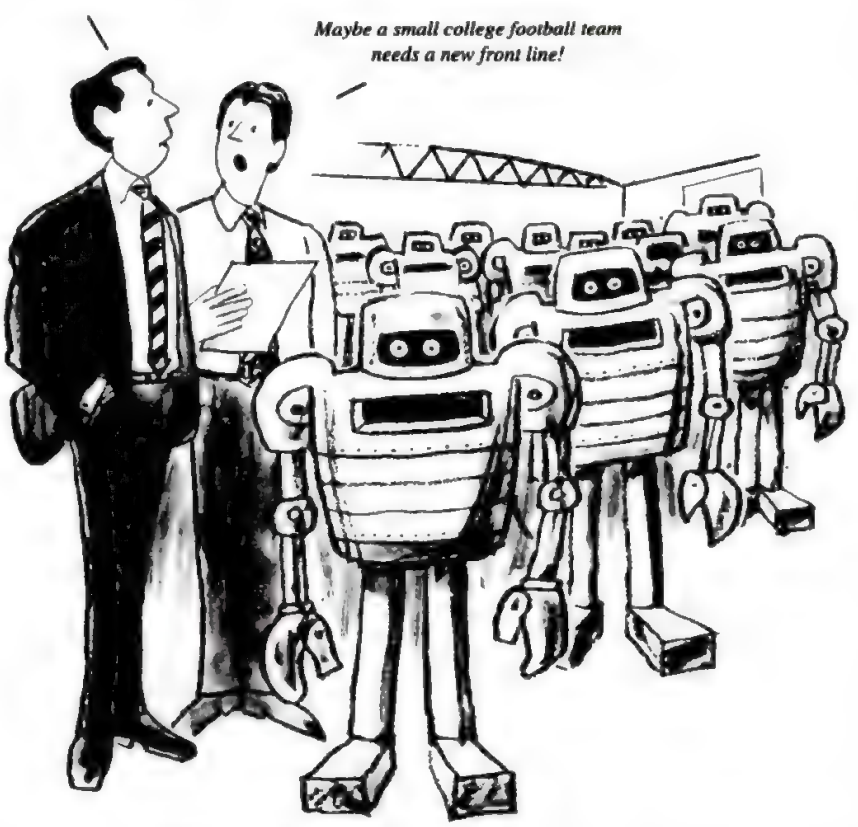

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Languages

USING COMPLEX NUMBERS IN TURBO PASCAL

I have been frustrated that Turbo Pascal does not provide users with the facilities to do various mathematical computations. The Math unit shown in Figure 1 was designed to overcome this deficiency. It handles the following operations:

- sinh
- cosh
- complex sinh
- complex cosh
- complex addition
- complex subtraction
- rectangular-to-polar coordinate conversion
- polar-to-rectangular coordinate conversion

USING COMPLEX NUMBERS IN TURBO PASCAL: Here's a set of functions that let you perform scientific calculations in TP.

- complex multiplication
- complex division
- complex exponential

I hope this routine will help other users as well.

Herbert Yang
Lexington, Virginia

We've all been mystified by the importance of the imaginary number *i*, the square root of –1. Complex numbers, consisting of a real portion and an imaginary portion, actually serve to define processes in the real world. And indeed it's handy to have a way to represent such numbers in Turbo Pascal.

Mr. Yang's original set of procedures simply used unconnected pairs of real numbers to represent the real and imaginary parts of complex numbers. They returned their results by modifying the first pair of parameters. I found this awkward, and decided instead to create a complex data type. Certainly it would be better to write a function that takes two complex variables as parameters, adds them, and

MATH.PAS 1 OF 2

```
UNIT Math;

{ This Unit is designed to meet the demand on
  Turbo Pascal to do scientific calculations  }

{**} INTERFACE {**}
TYPE
  CompStr = String[2*SizeOf(Real)];
  Complex = RECORD
              CASE Byte OF
                0 : (S : CompStr);
                1 : (len  : Byte;
                     R, I : Real);
                2 : (leng : Byte;
                     Rad, Theta : Real);
            END;

  FUNCTION C2S(C : Complex; w, d : Byte) : String;
  FUNCTION P2S(C : Complex; w, d : Byte) : String;
  FUNCTION sinh(X : Real) : Real;
  FUNCTION cosh(X : Real) : Real;
  FUNCTION CmpAdd(A, B : Complex)  : CompStr;
  FUNCTION CmpSub(A, B : Complex)  : CompStr;
  FUNCTION CmpMul(A, B : Complex)  : CompStr;
  FUNCTION CmpDiv(A, B : Complex)  : CompStr;
  FUNCTION CmpExp(X : Complex)  : CompStr;
  FUNCTION CmpSinh(X : Complex) : CompStr;
  FUNCTION CmpCosh(X : Complex) : CompStr;

  FUNCTION RecToPol(X : Complex) : CompStr;
  {rectangular to polar coordinates}
  FUNCTION PolToREC(X : Complex) : CompStr;
  {polar to rectangular coordinates}

{**} IMPLEMENTATION {**}
  FUNCTION C2S(C : Complex; w, d : Byte) : String;
  VAR RString, IString : String;
  BEGIN
    Str(C.R:w:d, RString);
    Str(C.I:w:d, IString);
    C2S := '(' + RString + ' + ' + IString + 'i)';
  END;

  FUNCTION P2S(C : Complex; w, d : Byte) : String;
  VAR RadString, ThetaString : String;
  BEGIN
    Str(C.R:w:d, RadString);
    Str(C.I:w:d, ThetaString);
    P2S := RadString + ' at ' +
                ThetaString + ' degrees';

  FUNCTION Sinh(X : Real) : Real;
  BEGIN Sinh := (Exp(X)-Exp(-X))/2; END;

  FUNCTION Cosh(X : Real) : Real;
  BEGIN Cosh := (Exp(X)+Exp(-X))/2; END;

  FUNCTION CmpAdd(A, B : Complex)  : CompStr;
  VAR Temp : Complex;
  BEGIN
    Temp.Len := 12;
    Temp.R := A.R + B.R;
    Temp.I := A.I + B.I;
    CmpAdd := Temp.S;
  END;

  FUNCTION CmpSub(A, B : Complex)  : CompStr;
  VAR Temp : Complex;
  BEGIN
    Temp.Len := 12;
    Temp.R := A.R - B.R;
    Temp.I := A.I - B.I;
    CmpSub := Temp.S;
  END;

  FUNCTION CmpMul(A, B : Complex)  : CompStr;
  VAR Temp : Complex;
  BEGIN
    Temp.Len := 12;
    Temp.R := (A.R * B.R) - (A.I * B.I);
    Temp.I := (A.R * B.I) + (B.R * A.I);
    CmpMul := Temp.S;
  END;

  FUNCTION CmpDiv(A, B : Complex)  : CompStr;
  VAR Temp : Complex;
    TempR : Real;
  BEGIN
    Temp.Len := 12;
    TempR  := Sqr(B.R) + Sqr(B.I);
    Temp.R := ((A.R * B.R) + (A.I * B.I))/TempR;
    Temp.I := ((B.R * A.I) - (A.R * B.I))/TempR;
    CmpDiv := Temp.S;
  END;

  FUNCTION CmpExp(X : Complex) : CompStr;
  VAR Temp : Complex;
  BEGIN
    Temp.Len := 12;
```

Figure 1: This Turbo Pascal unit contains a collection of functions for use with complex numbers.

MATH.PAS 2 OF 2

```
  Temp.R := Exp(X.R) * Cos(X.I);
  Temp.I := Exp(X.R) * Sin(X.I);
  CmpExp := Temp.S;
END;

FUNCTION CmpSinh(X : Complex) : CompStr;
VAR Temp : Complex;
BEGIN
  Temp.Len := 12;
  Temp.R := Sinh(X.R) * Cos(X.I);
  Temp.I := Cosh(X.R) * Sin(X.I);
  CmpSinh := Temp.S;
END;

FUNCTION CmpCosh(X : Complex) : CompStr;
VAR Temp : Complex;
BEGIN
  Temp.Len := 12;
  Temp.R := Cosh(X.R) * Cos(X.I);
  Temp.I := Sinh(X.R) * Sin(X.I);
  CmpCosh := Temp.S;
END;

FUNCTION RECtoPol(X : Complex) : CompStr;
VAR Temp : Complex;
BEGIN
  Temp.Rad := Sqrt(Sqr(X.R) + Sqr(X.I));
  IF Abs(X.R) > 0 THEN
    Temp.Theta := ArcTan(X.I/X.R) * 180/pi
  ELSE Temp.Theta := 90;
  IF (X.R <= 0) THEN
    BEGIN
      IF (X.I < 0) THEN Temp.theta := Temp.theta - 180
      ELSE Temp.theta := Temp.theta + 180;
    END;
  RecToPol := Temp.S;
END;

FUNCTION PoltoREC(X : Complex) : CompStr;
VAR Temp : Complex;
BEGIN
  Temp.R := X.Rad * Cos(X.Theta * pi/180);
  Temp.I := X.Rad * Sin(X.Theta * pi/180);
  PolToRec := Temp.S;
END;

END.
```

returns as the result a complex variable.

Unfortunately, it isn't as easy as that. Turbo Pascal functions can return ordinal types, floating-point types, strings, or pointers, but *not* record types. However, we *can* write a string function in such a way that the string actually contains the desired record data. To prepare for that, we define the variant record type complex as shown in Figure 1, which can be viewed either as a string or as a complex number. The S field is a 12-character string, which can legitimately be returned by a function. The next variant has a byte-size Len field that overlaps the S field's length byte plus two Real fields R and I to hold the real and imaginary parts of a complex number. The third variant is effectively the same as the second, but we've named the Real fields Rad and Theta, to represent the radius and angle of a set of polar coordinates.

All of the functions that return complex results do so by returning a string. They set the length byte to 12 and the two Real fields to their appropriate values. You can assign the S field of a complex variable to the result of any of these functions, and then access the numeric portions using the R and I fields. Program MathDemo shown in Figure 2 demonstrates just how to go about it. Run the program and enter various numbers to see

MATHDEMO.PAS COMPLETE LISTING

```
PROGRAM MathDemo;
USES math;  { this is a demo on how to use Math.TPU }

VAR
  X, Y  : Real;
  c1, c2, c3, c4 : Complex;

BEGIN
  WriteLn('Demo on using the sinh and cosh functions ');
  Write('Enter a value from -18 to 18 : ')
  ReadLn(X);
  Y := Sinh(X);
  WriteLn('sinh ', X:3:3, ' = ', Y:2:5);
  Y := Cosh(X);
  WriteLn('cosh ', X:3:3, ' = ', Y:2:5);
  Y := Sqr(Cosh(X)) - Sqr(Sinh(X));
  WriteLn('sqr(cosh ',X:3:3,') - sqr(sinh ',X:3:3,
          ') = ',Y:2:5);
  WriteLn('(should always be 1.00000)');
  WriteLn;

  WriteLn('Here we are going to test the complex ',
          'procedures. Enter complex numbers');
  WriteLn('A + Bi and C + Di.  Press ENTER after ',
          'each input.');
  Write(' Enter A : ');
  ReadLn(c1.R);
  Write(' Enter B : ');
  ReadLn(c1.I);
  Write(' Enter C : ');
  ReadLn(c2.R);
  Write(' Enter D : ');
  ReadLn(c2.I);

  c3.S := CmpAdd(c1, c2);
  WriteLn(C2S(c1, 3, 3),' + ',C2S(c2, 3, 3), ' = ',
          C2S(c3, 3, 3));

  c3.S := CmpSub(c1, c2);
  WriteLn(C2S(c1, 3, 3),' - ',C2S(c2, 3, 3), ' = ',
          C2S(c3, 3, 3));

  c3.S := RecToPol(c1);
  WriteLn(C2S(c1, 3, 3), ' in polar form : ',
          P2S(c3, 3, 3));
  c3.S := RECtoPOL(c2);
  WriteLn(C2S(c2, 3, 3),' in polar form : ',
          P2S(c3, 3, 3));
  WriteLn;
  c3.S := CmpDiv(c1, c2);
  WriteLn(C2S(c1, 3, 3),' / ',C2S(c2, 3, 3), ' = ',
          C2S(c3, 3, 3));
  c4.S := CmpMul(c3, c2);
  WriteLn('check: ',C2S(c3, 3, 3), ' * ',C2S(c2, 3, 3),
          ' = ', C2S(c4, 3, 3));

  WriteLn;
  c3.S := CmpMul(c1, c2);
  WriteLn(C2S(c1, 3, 3),' * ',C2S(c2, 3, 3), ' = ',
          C2S(c3, 3, 3));
  c4.S := CmpDiv(c3, c2);
  WriteLn('check: ',C2S(c3, 3, 3), ' / ',C2S(c2, 3, 3),
          ' = ', C2S(c4, 3, 3));

  WriteLn;
  WriteLn('Demo for complex exponential');
  WriteLn('Enter each value for A + Bi');
  Write('Enter A : ');
  ReadLn(c1.R);
  Write('Enter B : ');
  ReadLn(c1.I);
  c3.S := CmpExp(c1);
  WriteLn('EXP',C2S(c1, 3, 3), ' = ', C2S(c3, 3, 3));
  c1.R := 0;
  c1.I := 2*pi;
  c3.S := CmpExp(c1);
  WriteLn('EXP(0 + 2'6227'i) = ', C2S(c3, 3, 3));
  WriteLn('(should always be 1 + 0i)');

  WriteLn;
  WriteLn('Demo for complex sinh and cosh function ');
  WriteLn('Enter each value for A + j B ');
  Write('Enter A : ')
  ReadLn(c1.R);
  Write('Enter B : ');
  ReadLn(c1.I);

  c2.S := CmpSinh(c1);
  WriteLn('sinh',C2S(c1,3,3),' = ', C2S(c2,3,3));
  c3.S := CmpCosh(c1);
  WriteLn('cosh',C2S(c1,3,3),' = ', C2S(c3,3,3));
  c2.S := CmpMul(c2, c2);
  c3.S := CmpMul(c3, c3);
  c4.S := CmpSub(c3, c2);
  WriteLn('Sqr(cosh',C2S(c1, 3, 3), ') - Sqr(sinh',
          C2S(c1, 3, 3), ') = ', C2S(c4, 3, 3));
  WriteLn('(should always be 1 + 0i)');
END.
```

Figure 2: Program MathDemo puts the Math unit's complex functions through their paces and tests their accuracy.

the functions in action.

It's not easy to be sure that these complex functions are giving the right answers, so in most cases the MathDemo program includes a check. After performing a division, we multiply to get back the original operand, and vice versa. After finding the hyperbolic sine and cosine of a number, whether real or complex, we square the two results and take the difference, which should always be 1. And to check the complex exponential function, we calculate the value of $e^{2\pi i}$, which amazingly enough is exactly 1.

Note, though, that if you enter numbers much greater than 10, some of the

> It's not easy to be sure the complex functions are giving the right answers, so MathDemo includes a check.

identity checks will fail. For example, the difference between the square of a number's `cosh` and the square of its `sinh` should always be 1, but if you enter a number 15 or greater at the program's first prompt, you'll get 0 instead. The value of Exp(–15) in the `cosh` and `sinh` functions is so small compared with that of Exp(15) that there aren't enough significant digits to represent it, so `cosh` and `sinh` return the same value.

If you need to perform calculations using the fascinating complex number system, these functions will give you a good start.—*Neil J. Rubenking*

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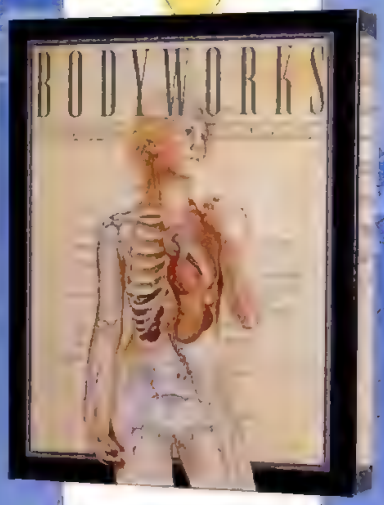

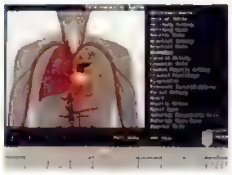

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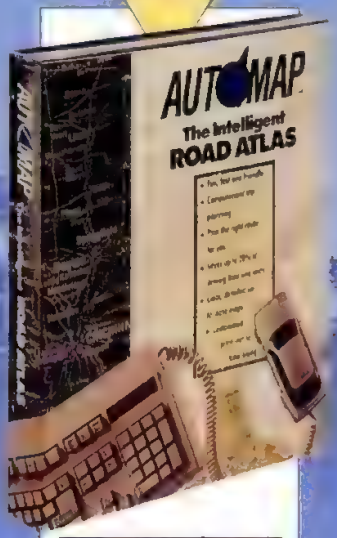

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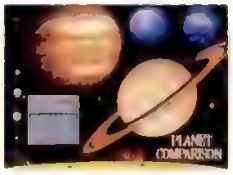

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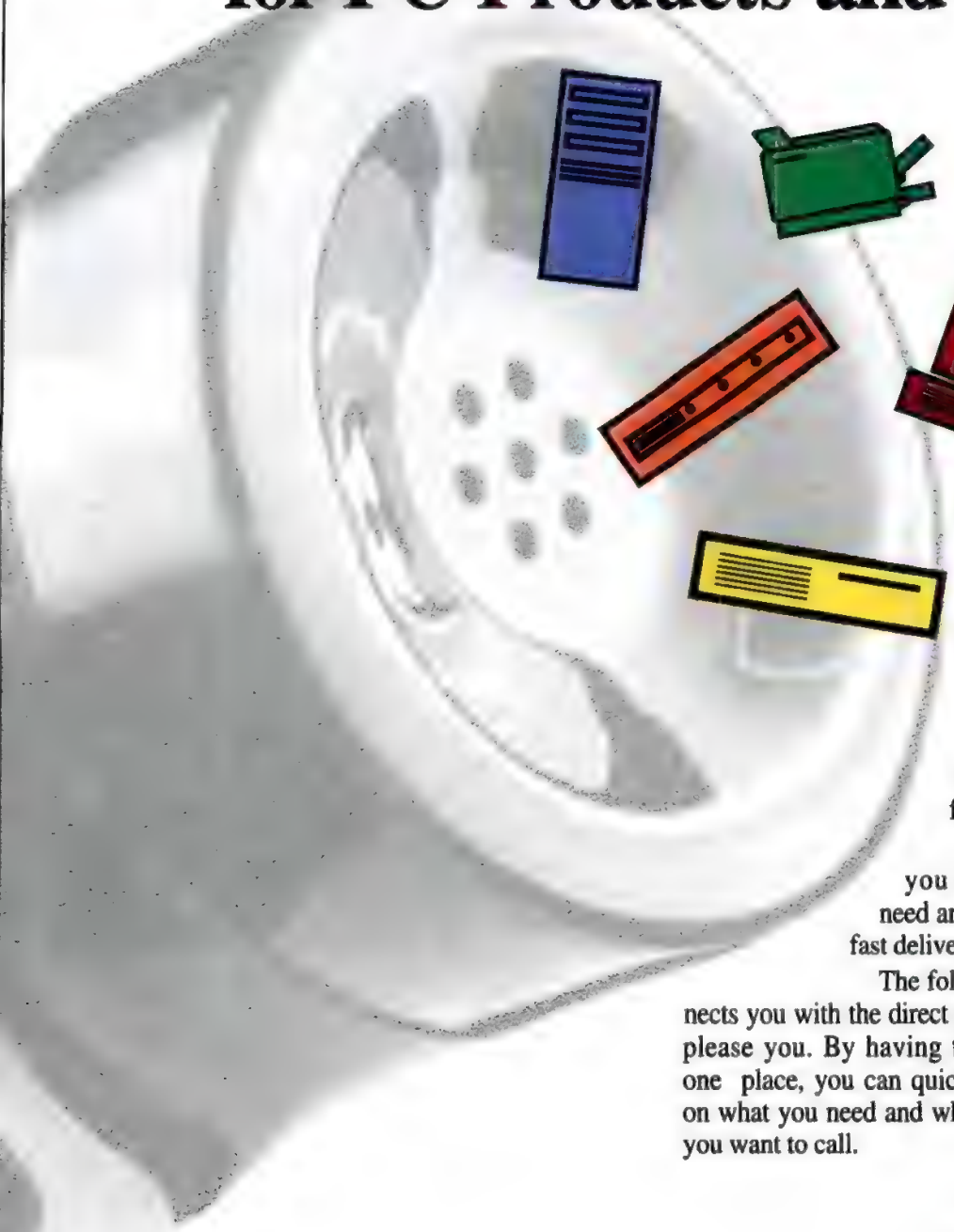

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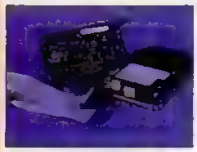

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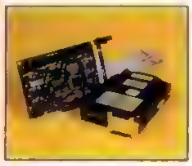

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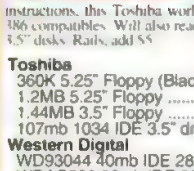

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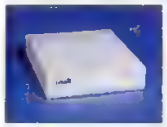

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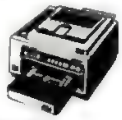

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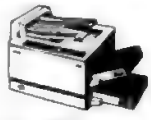

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2MB	APC-H655	$359
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2MB	APC-H655X	$389
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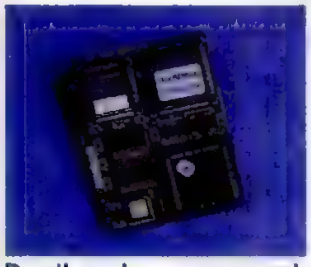

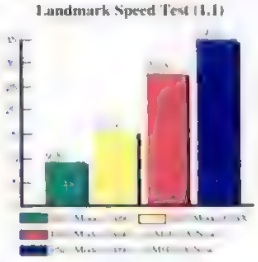

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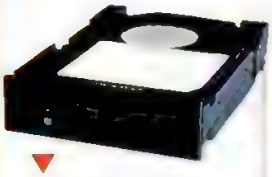

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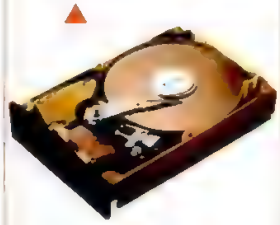

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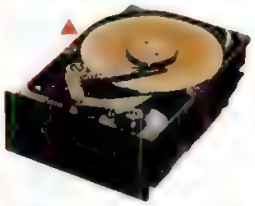

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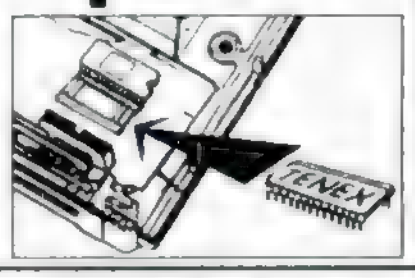

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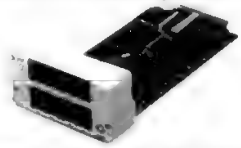

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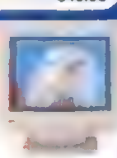

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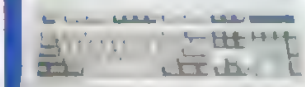

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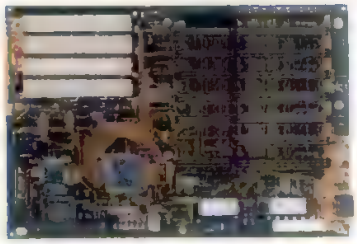

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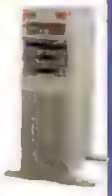

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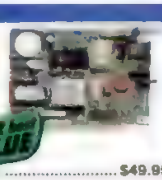

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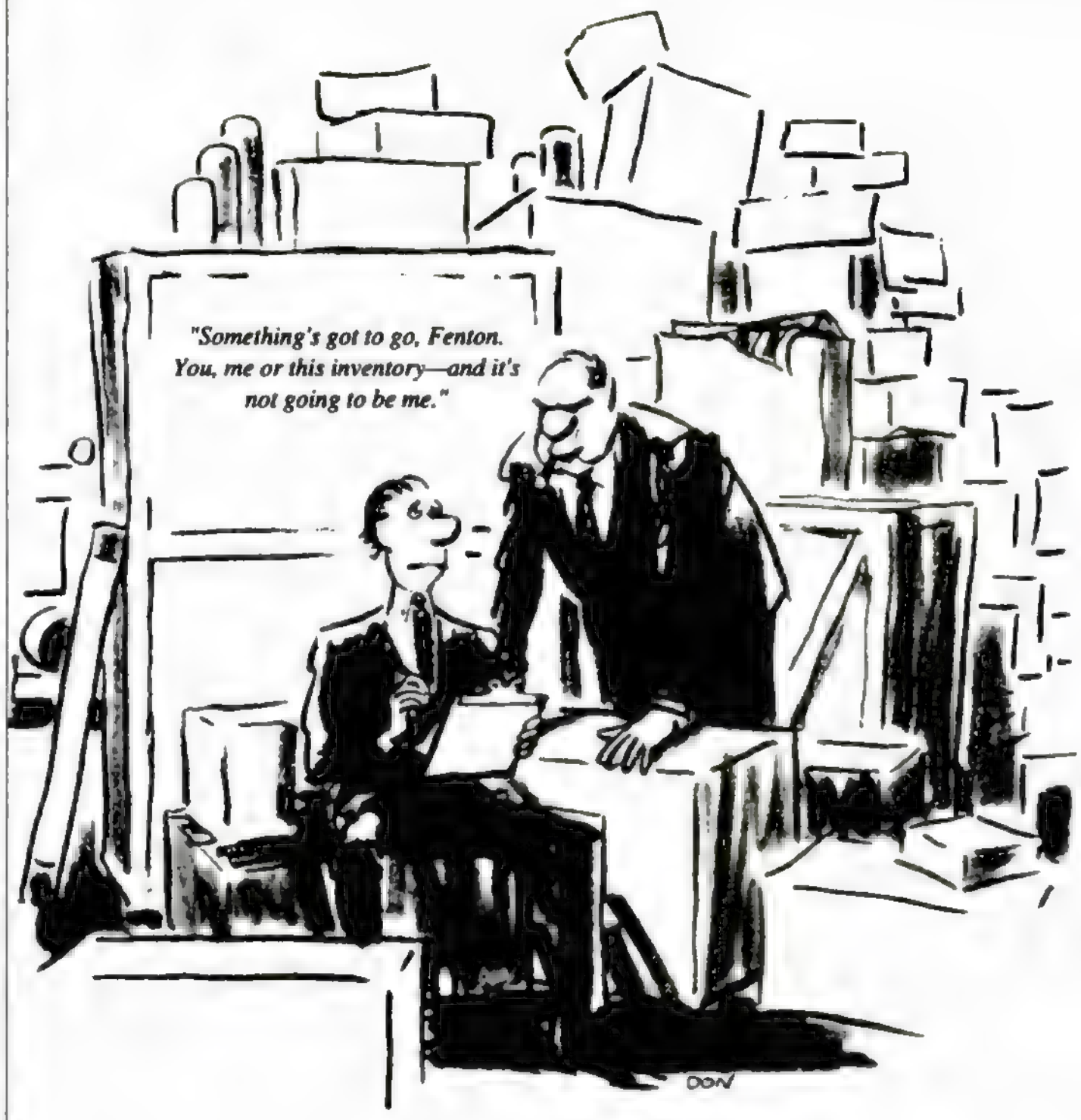

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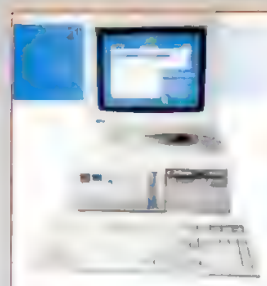

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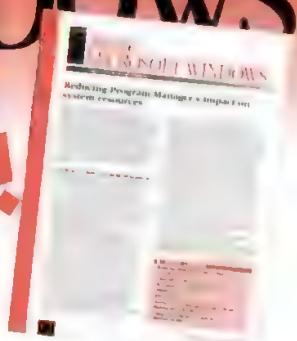

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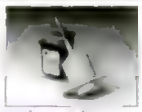

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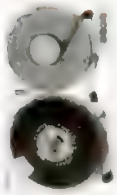

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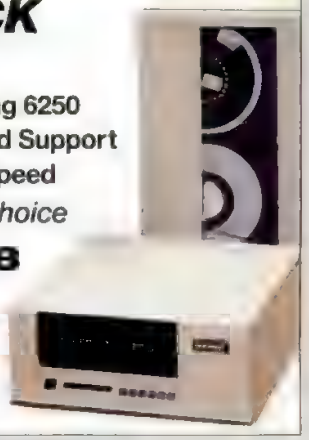

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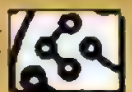

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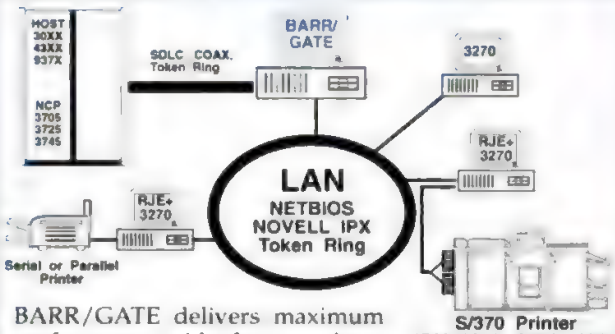

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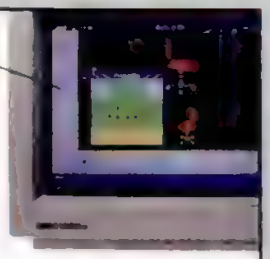

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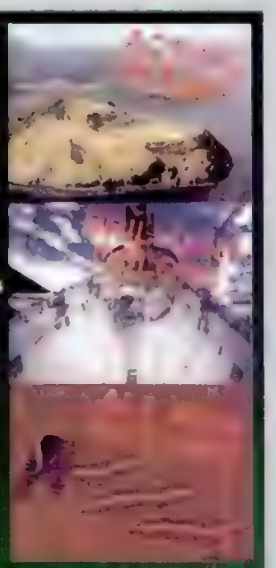

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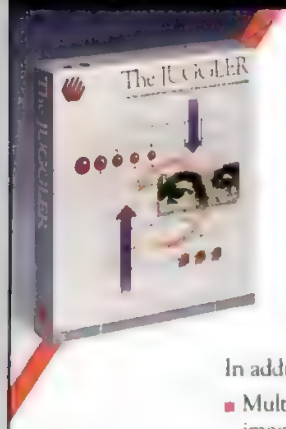

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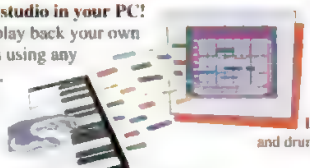

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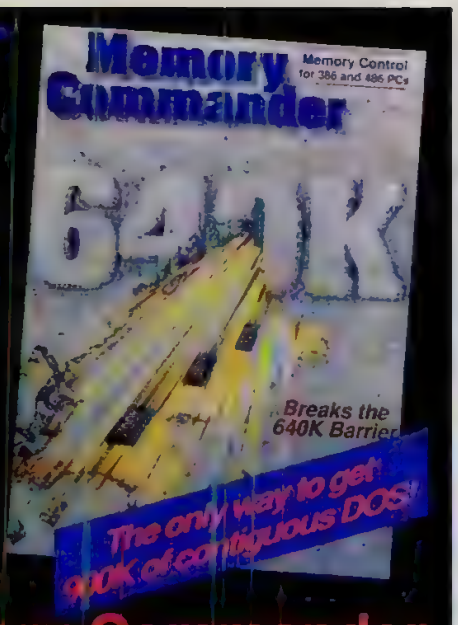

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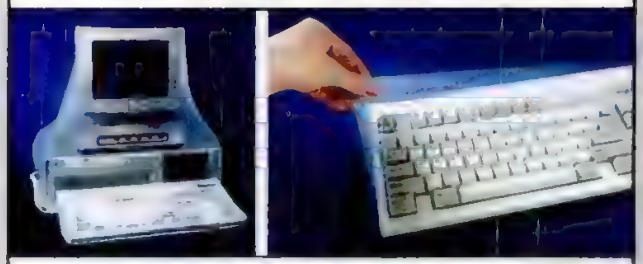

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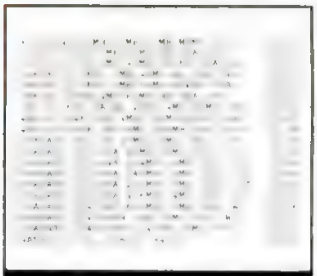

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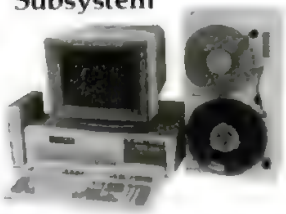

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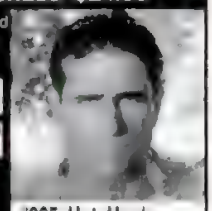

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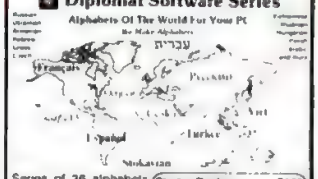

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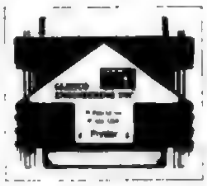

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1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116
1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128
1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140
1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152
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1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176
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Coming Up

■ 33-MHz 486 PCs

Server or workstation? Deluxe model or penny-pincher? Whatever your need and whatever your budget, you can find a 33-MHz 486 that fills the bill. Once the top of the power and price lines, these desktop and tower 486/33s may have bowed to 486/50s, but they've dropped steeply in price, too: It can cost as little as $3,000 for a system with 8MB of RAM, a 200MB hard disk, and blazing graphics capabilities. *PC Magazine* reviews 24 33-MHz 486s.

■ WIRELESS LANs

Using a full-featured office LAN used to mean wrestling with miles of cabling of every description—no cables, no LAN. No more. We review three of the most full-featured wireless LANs on the market—each of which uses a different technology to transmit data—and compare throughput, convenience, and cost.

■ AUTOCAD UTILITIES

AutoCAD is the world's most popular CAD package, partly because of the tremendous support from third-party vendors. *PC Magazine* asked two CAD experts to take a look at ten file viewers and nine text editors for use with *AutoCAD*. The experts found that no drafter should be without some of these packages, while other choices seem to be first drafts.

■ REPLACEMENT KEYBOARDS

Just because you need a new keyboard doesn't necessarily mean that you need to buy a brand-new system. But you do need to consider size, cost, compatibility, and key layout, not to mention whether or not you want a "clicky" or "mushy" feel. In the next issue, PC Magazine Labs tests 17 replacement keyboards.

■ MEMORY MANAGEMENT UTILITIES

DOS 5.0 has won accolades for its ability to load drivers into high memory and free up more conventional memory, but memory management utilities have been getting around the 640K barrier for years. In 1992, most memory managers have been upgraded with automatic optimizers and new techniques for maximizing memory, be it conventional, expanded, or extended. PC Labs tests nine of these products, including the latest versions of *386MAX*, *NetRoom*, and *QEMM-386*.

■ LAB NOTES

Like DOS, Windows relies on undocumented API functions. In the next issue, we will continue toward our goal of assembling a "top twenty" list of undocumented functions, examine Microsoft's own use of these functions, and discuss how you can safely use undocumented functions.

■ UTILITIES

ADDIT.COM is a DOS TSR utility designed to sum a series of numbers directly on-screen. It's not another pop-up calculator: ADDIT captures numbers directly from the screen, adds them, and presents the sum to you quickly, simply, and accurately. To ensure accuracy, ADDIT can even paste the sum directly into your DOS program. ■

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After Hours

Products for the Leisure Side of Personal Computing

Pounding the Keyboard For the Right Career

CAREER SOFTWARE
by Greg Pastrick

Pounding the pavement for that perfect job—or any job, for that matter—is at best a challenging adventure and at worst, a demoralizing experience. Given today's job marketplace, scattershot mailings of standard-issue resumes are simply a waste of paper and stamps. Better to spend $99 and work with *Career Design*, an expert system–like package developed in conjunction with the Crystal-Barkley Corp. career assistance firm. With its solid career development techniques, this package has the potential to put you on a direct path to the job you want.

Career Design is an interactive self-help package that consists of tightly integrated modules that direct users through a series of exercises. These exercises—such as determining your basic, specific, and personality skills and identifying your likes and dislikes concerning work conditions and types of personalities—take place in the program's built-in word processor. The particular modules ask questions, and you type your responses. Underlying all of these modules is a structure that leads any serious user to perform the necessary soul-searching needed to identify a career strategy successfully.

At its simplest level, the program's structure is driven from personal files you build by answering the general questions: Who am I? What do I want? And how do I get there?

Constant user feedback is one of *Career Design*'s great strengths. Throughout all the questioning and prompting and your answers, which form the basis of its modules, the quality of information is instructive and guiding: conversational and human in tone, but precise in meaning. The deeper you enter, the better information you get back. Further entries lead to substantial on-screen discussions of the more specific answers you enter. True to the mature quality of the feedback, responses never resort to the "Try Again" prompting found in many programs. And due to the personal nature of the information you input, the program is password protected.

Career Design is all about effective self-marketing, and the program's interactive modules should help you develop a structured career search plan. *Career Design*'s approach centers on thorough preparation. And while the program's interaction with the user is heavily devoted to self-analysis, the body of the program is devoted to action—setting goals, gathering information from companies, and generating high-yield contacts with potential employers or clients. Typical of this approach, *Career Design* favors specific proposals that meet well-researched needs over cold calls and resumes. As such, the software requires significant self-motivation.

Significant typing is also needed, since the more effort you put into completing the modules, the better you teach yourself the strategies necessary to shape a successful career. Skipping through modules is possible, but the most benefit is gained by methodically following the path laid out by the program's recommended sequence.

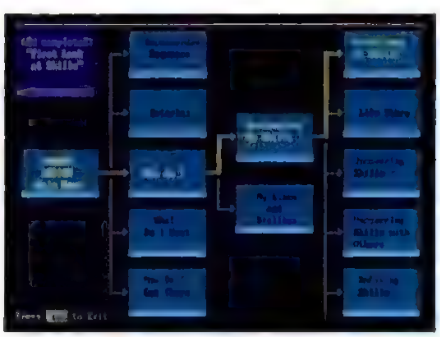
You'll find little help or guidance outside of the program. The documentation is in the help screens attached to the modules. The most you'll get from the manual is some direction on printing and a good listing of standard references to aid in researching companies. Further, the generic word processor offers limited functionality, but proposals, resumes, cover letters, and thank you notes may be fine-tuned in your favorite word processor.

Measured by the state of job competition, *Career Design* is a timely piece of software; and by any measure it's valuable for guidance in personal and career assessment alone. Armed with the self-marketing savvy, techniques, and tools contained within this thoughtful guidance tool, you can't help but mount a successful career search.

List Price: *Career Design*, Version 1.4C, $99. Career Design Software, P.O. Box 95624, Atlanta, GA 30347; 800-346-8007, 404-321-6100.
Requires: 525K RAM, DOS 2.0 or later.

CIRCLE 406 ON READER SERVICE CARD

- **CAREER SOFTWARE** What color is your parachute? *Career Design* and *Career Options* will help you decide.
- **COLLEGE** Software tools to help you find the right college, choose a major, and pay your way.
- **ENTERTAINMENT** Defend the galaxy against the Kilrathi in the second installment of Origin's *Wing Commander*.



***Career Design*'s overview map reveals your position inside the program. By placing markers you can easily return to uncompleted modules.**

Find a Career by Identifying Your Traits and Preferences

CAREER SOFTWARE
by Don Trivette

Peterson's Career Options, the $295 guidance package from Peterson's, uses a set of personal assessment exercises to gauge your interest in particular careers. You choose from areas of interest like Arts & Entertainment, Sales, Social Service, Engineering, Business Operations, and Sports. The software then asks dozens of specific questions: "Would you like to

CONTINUES

Career Options

CONTINUED

compose, perform, or teach dancing?" (No.) "Would you like to perform daring acts that require physical skill?" (Yes.) "Would you like to make a lot of money?" (Yes!)

Peterson's software builds a pool of potential careers, usually with hundreds of possibilities. To reduce the pool to a more manageable size, there are eight work preference areas, each of which contains questions that focus on specific likes and dislikes. There's an area for working conditions ("Do you like to work alone?") and another for skill levels ("Rate your space perception—low, medium, or high").

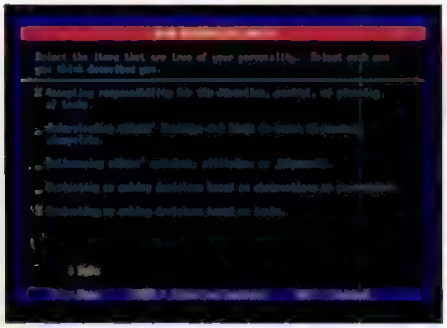
Long before you've finished the personal assessment, you are likely to find you have reduced your pool of choices to zero, as I did, and have to reanswer some questions less idealistically. (Sigh—I gave up money.) Soon you'll have a manageable list of career options, some of which may surprise you. Although I have a degree in design and happily make a career of writing, *Peterson's Career Options* thought I would be good as a police artist (no) or a laser technician (maybe).

Other ways to explore the information in the database include looking at careers in related areas and by specific occupation. A one-sentence description of each potential occupation is available ("tests and analyzes laser devices") along with the training level required ("some college") and related college majors ("optical technologies").

The descriptions are the weakest part of *PCO;* most of the information is too general to be of value. I want a detailed description of each career (see sidebar, "Three Job Guidance Titles Merge on One CD"), including the number of people so employed, the salary range, and projections for future jobs. The developers point out that *Peterson's Career Options* is a place to start, and the program refers you to printed literature for more detailed information. If nothing else, *PCO* will point you to areas you had never considered, but you can probably achieve the same results by reading a good career book.

List Price: *Peterson's Career Options,* $295. Peterson's, P.O. Box 2123, Princeton, NJ 08543-2123; 800-338-3282. **Requires:** 256K RAM, DOS 2.1 or later.

CIRCLE 407 ON READER SERVICE CARD



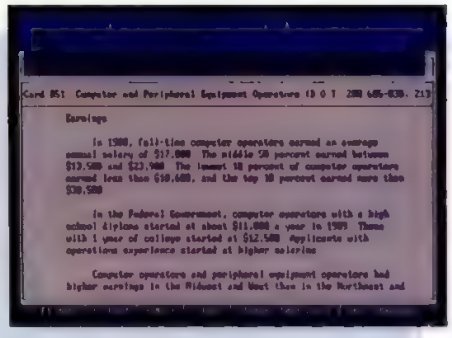
After you identify traits that describe your personality, *Peterson's Career Options* uses this information to point you toward possible careers.

THREE JOB GUIDANCE TITLES MERGE ON ONE CD

Career Opportunities, a new career-related CD-ROM from Quanta Press, is a computer-searchable version of three hard-bound books: *The Federal Career Guide, Occupational Outlook Handbook,* and *Your Military Today.* The first covers federal careers; the second, private-sector jobs; and the third is a book about civilian-related military employment (sorry, no tank commanders or Navy Seals).

These books, totaling more than 10,000 pages in printed form, are well known to career and guidance counselors. The *Occupational Outlook Handbook,* published by the U.S. Dept. of Commerce, is a definitive reference source with salary ranges, detailed job descriptions, qualifications, current employment statistics, and job outlook projections—all the things that are missing from the other packages in this roundup.

While *Career Opportunities* can't analyze your preferences, make suggestions, or point to colleges, it is a good way to learn a lot about specific careers you already have in mind.—*DT* ■

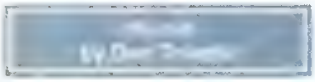


***Career Opportunities* provides specific salary ranges and job outlooks, such as this listing for government computer operators.**

List Price: *Career Opportunities,* $129. Quanta Press Inc., 1313 Fifth St. SE, #208C, Minneapolis, MN 55414; 612-379-3956. **Requires:** 640K RAM, CD-ROM drive, DOS 3.0 or later.

CIRCLE 408 ON READER SERVICE CARD

Finding the Right College, Paying for It, and Choosing The Right Courses



Next fall there will be 13.6 million students attending this country's 3,500 institutions of higher education—public, private, two-year, and four-year. The average bill for students attending public schools will be over $5,200, while those at private institutions will pay an average of $13,300 for tuition, fees, and room and board.

Finding the right college, gaining admission, and paying the bills are some of the most perplexing issues facing college-bound high-school students and their parents. There are a variety of computer programs and services that promise to make this task easier; some actually do.

Peterson's, one of the leaders in the marketing of higher education and the publisher of *Peterson's Career Options* (see above) covers all bases with its *College Selection Service* and *Financial Aid Service* packages.

A second marketer of "college" software, Education Information Systems, offers *How to Choose the Right College, How to Choose the Right Major,* and *How to Plan for College.* (The last, not reviewed here, is an electronic worksheet with tips for planning and organizing your high-school career with an eye toward college.)

Although a college major and a career are not exactly synonymous, they are roughly equivalent from a high-school senior's perspective. *How to Choose the Right Major*'s main menu features such tantalizing topics as "Getting to Know Yourself," "Tips on Choosing a Major," and "Hot Careers for the '90s." I must confess that I would be more apt to read this information in printed form; fortunately, the software has a print option.

Right Major takes a different approach from Peterson's *Career Options.* Instead of a Q&A analysis, *Right Major* has suggestions for getting to know yourself: your likes, your dislikes, and your talents. "Make a list of things you enjoy doing," the program counsels.

The database consists of col-

CONTINUES

College

CONTINUED

leges and their areas of strength—a big help if you already have a major in mind. The information is remarkably complete and can be searched either by school or by subject, but a flaw in paging won't let you scroll through the database in both directions, so there's no going back.

WHERE TO BEGIN

Once you have a career or major in mind (or even if you don't), you can begin to choose a college. Peterson's *College Selection Service* helps guide you through the higher-education maze. The bad news is that the program—really one for two-year schools ($109) and another for four-year institutions ($159)—is both expensive and constantly being updated as colleges change requirements and raise tuitions. The good news is that you don't have to buy the vineyard to enjoy the wine—Peterson's *College Selection Service* is available on several computer networks, including Dow Jones News/Retrieval, CompuServe, and Dialog. *CSS* becomes economical when purchased for a high-school guidance office; site licenses are available.

How to Choose the Right Major **lets you search by subject or selected university, as shown here.**

College Selection Service is a wise and patient counselor. It asks about your preferences and then makes recommendations based on your answers. Included are queries about location, coed/single sex, size, public/private, campus setting, entrance difficulty, sports, costs, campus life and activities, ethnic/geographic mix, admissions requirements, and application deadlines.

After making a selection, the number of colleges in the pool shrinks. For example, you begin with about 3,400 institutions, but by picking a campus setting near a major metropolitan area (500,000+ population), your list falls to 777. Once you've narrowed the list to suit your preferences, *CSS* lets you find out about the schools, including address, general information, freshman admissions, expenses, housing, athletics, and majors.

For the price of a couple of evening hours on any of the four major computer networks—less than $20—you can get expert advice about selecting a college. That's a bargain.

EIS takes much the same approach with its *How to Choose the Right College*. The questions are similar to those in Peterson's, with a few exceptions. *Right College* asks for your SAT scores and displays them beside the ranges for the school(s) in your pool. At Rice University, for example, three-quarters of the freshmen class had math SAT scores greater than 640. Information like that can be valuable when you consider the $50 to $75 fee that must accompany each application.

Detailed information for schools is presented in an easy-to-compare tabular format, while *College Selection Service* uses a narrative format. *Right College* has textual information like "College Today: The Reality," "All About College Rankings," and "How to Evaluate Colleges After Searching." Another nifty feature is the letter-writer, which addresses form letters for more information to the admissions offices of the schools you select.

PAYING FOR IT

As part of the college selection process you may need to consider financial aid. *Right College* has 11 screens of tips and information, but frankly, financial aid is not its forte.

Peterson's *Financial Aid Service* is a database and worksheet that should be required software for college-bound students and hard-pressed parents. First you answer a series of questions about your family and its income; then, based on a Congressional formula, the program tells you whether you are likely to be eligible for federal aid. If you are a traditional middle-class American family, you probably won't be—but don't give up.

In addition to covering financial aid programs in depth, Peterson's *Financial Aid Service* also includes scholarships and grants from private sources.

I didn't qualify for government aid. But after asking me a series of obtuse questions about the type of employment I had in high school (paperboy), ethnic heritage (Colonial American), class rank (top quarter), and organizations to which I belonged (Boy Scouts), the software concluded that I was eligible for 45 private grants and scholarships.

The scholarship and loan sources are drawn from a database of 480; my own possibilities included the Colonial Dames of America and a fun-sounding Duracell competition where I could create and submit a battery-operated device. Detailed information on each scholarship or loan is in the database.

It's hard to imagine more valuable information than that given in Peterson's *Financial Aid Service*, but at $195 it's priced beyond the means of many who need it most. You can, however, insist that your high school buy a copy.

For picking a college I like both Peterson's and EIS's products; they cut to the facts without all the admissions-office hyperbole and gushing recommendations. I'd try Peterson's on-line version first, then buy EIS's *How to Choose the Right College* if I needed more help. For financial aid, Peterson's has an unbeatable product—it can literally be a gold mine.

List Price: *College Selection Service* (two-year schools), $109, (four-year schools), $159; *Financial Aid Service*, $195. Peterson's, P.O. Box 2123, Princeton, NJ 08543-2123; 800-338-3282. **Requires:** 256K RAM, DOS 2.1 or later.

CIRCLE 409 ON READER SERVICE CARD

List Price: *How to Choose the Right College*, $79.95; *How to Choose the Right Major*, $79.95. (These two programs along with a third, *How to Plan for College*, are bundled for $179.95.) Education Information Systems Inc., P.O. Box 5125, Ridgewood, NJ 07451; 201-882-4581. **Requires:** 390K RAM, DOS 3.0 or later.

CIRCLE 410 ON READER SERVICE CARD

Wing Commander II: The Saga Continues

ENTERTAINMENT
by Bernie Yee

Origin Systems' original *Wing Commander* epitomized the best of the new breed of computer games: real-time action with graphics, music, and sound, linked with a B-movie plot line that any *Star Wars* fan would love. The classic starfighter "simulation," it featured a simple storyline: You are an unproven starfighter pilot, catapulted into the middle of an epic war with the Kilrathi. Your heroic deeds against overwhelming odds are the stuff of which legends—and now sequels—are made.

Wing Commander II: Vengeance of the Kilrathi is less ground breaking, but no less dazzling. Incorporating improved VGA graphics and optional digitized

CONTINUES

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Jonathan D. Lazarus/Microsoft Corporation
General Manager, Systems Software Marketing

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Technology Architecture Manager

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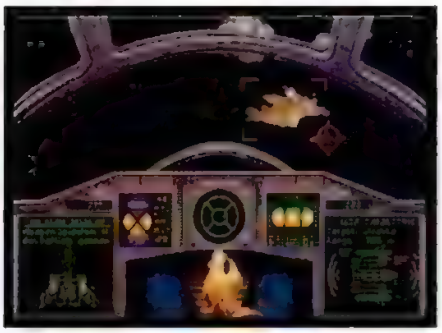
CIRCLE 158 ON READER SERVICE CARD

Wing Commander II

CONTINUED

speech for Sound Blaster owners, Origin has pushed the state of hardware art to its limit; nowhere is the need for CD-ROM more obvious. *Wing II* and the Speech Accessory Pack ($19.95 extra) will gobble up to 21MB of your hard drive, and has the ignominious distinction of reaching the $100 retail price barrier. Another sequel called "Special Operations" is scheduled as well, but won't be out until December or January.



***Wing Commander II* pits you against the Kilrathi stealth fighter, though they prove to be fairly easy game.**

The sequel picks up after the end of *Wing Commander and the Secret Missions*, but the present is less kind to your hero—you are framed and court-martialed at the onset. Banished to the equivalent of the Coast Guard, you are saddled with uneventful missions—until, by sheer chance, you get the opportunity to clear your name by defeating the Kilrathi prince and the human traitor who framed you.

Like the original, *Wing Commander II* consists of a number of combat missions linked together by sequences that advance the plot. Origin has also created a much more detailed storyline for *Wing II*—realizing that it was the plot that made the original so successful. Sadly, there is still no interaction outside your cockpit. Only by accomplishing each mission do you advance the storyline. But *Wing II* really shines in the cockpit; the graphics and animation are smoother than ever, and game pauses for disk accesses are almost imperceptible. However, the program is not without some problems: *Wing II* crashed once and reported a recoverable error another time.

Though sufficient to get you started, *Wing II*'s few measly pages are hardly the kind of documentation that you would expect to accompany a pricey game that will surely tax any system less than a 386SX-16 to the point of exhaustion.

Still, with a smorgasbord of energy, missile, and torpedo weapons available and "Dynamic Intelligence" to improve the flying of all computer-controlled pilots, *Wing II* is an armchair pilot's dream.

Wing Commander combined a dazzling mixture of gaming elements. Even though it only offers nothing new, *Wing II* continues the tradition with spectacular graphics, sound, and action that will occupy much of your time, imagination, and hard disk. I can't wait to see what its designers will do when they have 600MB on a CD-ROM to work with. ■

List Price: *Wing Commander II: Vengeance of the Kilrathi*, $79.95; Speech Accessory Pack, $19.95. Origin Systems, 110 Wild Basin Rd., #230, Austin, TX 78746; 800-999-4939, 512-328-0282. **Requires:** 12-MHz 80286 or better, 584K RAM, EGA graphics or better, DOS 3.3 or later.

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meca®

by Bill Howard

Abort, Retry, Fail?

The Lighter Side of Personal Computing

Mea Culpa

"In addition to the graphics coprocessor, the ATI card houses ATI's VGA chip, 256K of dedicated VGA memory, a mouse port, and a Microsoft-compatible mouse in a card that is only 6 inches long."

—*PC Magazine*, November 26, 1990

Popular button at Fall Comdex. Nearly half of Ashton-Tate's staff was released after its acquisition by Borland.

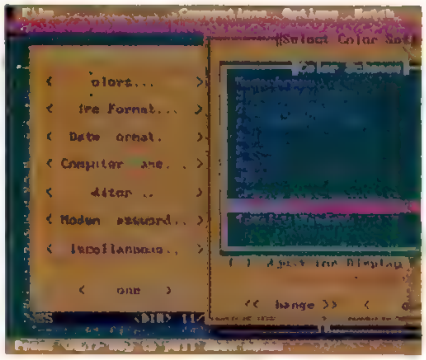
AT DEADLINE

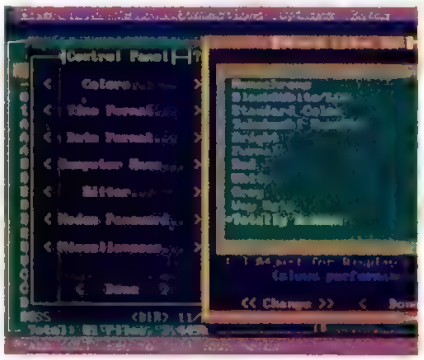
IBM to shave 325,000 workers from payroll

IBM chairman John Akers confirmed last week that an additional 20,000 employees worldwide would be cut, bringing down the total employed to about 325,000, from a 1986 high of 400,000. Two-thirds of the work-force reductions are expected to take place in the United States. The remaining one-third will affect IBM's international operations — specifically Europe, according to sources briefed by IBM last week.

IBM also announced last week that it will take a $3 billion charge against earnings to cover the job cuts and other reorganization efforts. Although the charge will [illegible] current quarter, IBM offi[illegible] billion[illegible]

Well, mistakes do happen on deadline: *InfoWorld* (December 2, 1991) overstates IBM's workforce reduction by some 300,000.





Don't like the vanilla screen-color choices you get with most software? Try one of these 11 options on Traveling Software's *LapLink Pro 4* file-transfer program: Takahashi Sunrise (lime green and yellow on black); Way Ugly (light green, purple, off-yellow, brown, and magenta), above; or Totally Random, below.

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness, and completeness of each entry are considered. Winners this issue: Steven Manes (ATI video card), Daniel Fabrizio (IBM payroll).

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7 NOTEBOOK USERS WERE LOCKED IN A ROOM. LESS THAN 4 HOURS LATER, 6 OF THEM WERE DEAD.

OK, we didn't really lock anybody up. But an independent laboratory did run *PC Magazine's* Battery Rundown Test on 7 leading notebook computers. And we're happy to report that Dell came in dead last.

In fact, Dell's power management system and NiMH battery helped the 320N+ run a full 30 minutes longer than the nearest competitor. More than enough to get you through the next marathon meeting or epic plane flight.

And, Dell has found a way to make your budget last longer too. Because at $2,999, the 320N+ costs up to a third less than most of the competition. And still includes Dell's award-winning service and support. Which can get a trained technician right to your home, office or hotel room; usually by the next business day.△

Just what you'd expect from a company that's become a $546 million international business in just 7 years. And one of the most awarded PC manufacturers in the world.

So call us and order a Dell 320N+ today. Either way, you won't have to be afraid of dying any more.

You charge less.

Dell 320N+	**4:00 Hours**
Toshiba T2000SXe	*3:21 Hours*
Compaq LTE 386s/20	*3:05 Hours*
TI Travelmate 3000	*2:32 Hours*
Zenith MastersPort 386SL	*2:26 Hours*
AST Premium Exec	*2:08 Hours*
IBM PS/2 Model L40SX	*1:55 Hours*

Test in accordance with PC Magazine's testing parameters.

We charge less.

Dell 320N+ 4 MB RAM and 60 MB Disk Drive	**$2,999**
Toshiba T2000SXe—4 MB RAM and 60 MB Disk Drive	$4,178
*Compaq LTE 386s/20—4 MB RAM and 60 MB Disk Drive**	$4,297†
TI Travelmate 3000—4 MB RAM and 60 MB Disk Drive	$3,498
Zenith MastersPort 386SL—4 MB RAM and 60 MB Disk Drive	$4,798
AST Premium Exec.—4 MB RAM and 80 MB Disk Drive	$3,295*
IBM PS/2 Model L40SX—4 MB RAM and 60 MB Disk Drive	$4,545

**4 MB and 60 MB Disk Drive retails for $400 more. Go figure.*

Actual dealer prices may vary.

DELL 320N+ $2,999

TECH STUFF

Dell 320N+ 20 MHz i386SX System ▰ Lease◊: $112/MO.** ▰ 6.8 lbs ▰ 8 1/2 x 11" footprint ▰ Full-travel keyboard ▰ 4 hour battery life on NiMH battery ▰ System includes 60 MB Hard Drive, VGA Edgelit LCD, 4 MB RAM ▰ 80 MB Hard Drive also available

SERVICE AND SUPPORT

Nationwide on-site lapside service contract included in the system price the first year^ ▬ Toll-free technical support hotline ▬ Self-diagnostic software ▬ Free factory installation of selected MS-DOS® software applications

COMPANY AWARDS

Dell has won *PC Week* Corporate Satisfaction Polls an unprecedented 8 times ★ Dell ranked Best Personal Computer in Small to Medium Sized Businesses in the J.D.Power and Associates® Customer Satisfaction Index ★ Dell has won *PC World's* 1991 World Class Award for Best Service and Support/Hardware

To order, call. Please reference 11BQ6

800-627-1470

Mon-Fri between 7am-9pm CT, Sat 8am-4pm CT, Sun 10am-3pm CT ▰ In Canada, (800) 668-3021 ▰ In Mexico, 95-800-010-0664 ▰ Shipped with a 30-day no questions asked money-back guarantee

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DELL COMPUTER CORPORATION

Fasten your seat belts. Because now you can get the speed and power of an i386™ system without laying out any serious dollars. Or having to deal with a suspect company.

It's the Dell® 325P for only $1,799. This full-blown 25 MHz, i386DX system with a 40 MB hard drive offers maximum performance at the lowest possible price. So it's ideal for any mainstream business application. And it comes from Dell, a company that has built a $546 million international business in just 7 years.

When you buy from Dell, you always deal with us directly. So there's no high dealer margins or erratic support. You'll get a computer we designed, manufactured, and rigorously tested ourselves. And it comes with the service and support that helped us become one of the most awarded PC companies in the world.

So don't wait. Call us today for the Dell 325P.

Because even though the price is stripped down, the computer isn't.

IT'S KIND OF LIKE GETTING A PORSCHE FOR THE PRICE OF A YUGO.

Lease◊: $67/MO.**

TECH STUFF

i386DX 25 MHz processor ▬ Upgradeable to i486™DX 33 MHz processor ▬ 2 MB RAM (expandable to 16 MB) ▬ 40 MB, 28ms IDE Hard Drive ▬ 640 x 480 VGA Color Monitor ▬ 5.25" 1.2 MB or 3.5" 1.44 MB Floppy Drive

SERVICE AND SUPPORT

On-site desk-side service contract included in the system price the first year◊ ▬ Toll-free technical support hotline ▬ Toll-free TechFax℠ line for 24-hour system information ▬ On-line Bulletin Board communication with technical staff and other users ▬ Self-diagnostic software ▬ Free factory installation of selected MS-DOS® software applications ▬ Information Service Support Forum on CompuServe

COMPANY AWARDS

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